Libya — Al-Mamlaka al-Libiyya al-Muttahida

A. The Area of Libya: Physical Geography

Introduction

Geographical Outline

Geographical co-ordination and position

Western border: 1100 km between 33° 50′ N. 11° 52′ E. and 23° 40′ N. 10° 56′ 40″ E.

Eastern border: 1400 km between 31° 40′ N. 25° 10′ E. and 19° 40′ N. 24° E.

Southern border: 1700 km.

In certain parts the frontiers have been arbitrarily drawn as straight lines. The northern border is formed by the coast of the Mediterranean; it is 1900 km in length.

The Kingdom of Libya is contiguous to the following states:
The Republics of Tunisia and Algeria in the west,
the Republics of Egypt and Sudan in the east,
the Republics of Niger and Chad in the south (Map 17).

Area of the country: 1,759,540 square km.

Population: 1,559,399 inhabitants (1964).

Even great efforts could probably only bring 1% or 17,600 square km. of the area of the country into agricultural use, 0.4% or 7040 square km. of which are under the plough (equal to 2²/₃ times Luxembourg's 2568 square km.). Grazing land totals c. 14 million hectares (140,000 square km. or 7—8%).

The three countries (1964):
[since 1964 newly divided into 10 provinces (vide population movements) by royal decree April, 27, 1963].

Tripolitania

263,960 square km. with 1,029,216 inhabitants (3.90 per square km.), 376,177 of whom live in and around the city of Tripoli (212,577 in the city proper), 370,366 in the Jefara and Jebel, 282,673 in Homs and Misurata District (Roman Daphnia) — in all 63.4% of the population. 400,000 hectares are continuously cultivated and in addition 100,000 hectares are irrigated (80,000 of which are in the so-called Tripoli Square, 16,000 being irrigated); grazing land (and land under rain cultivation) totals 8 million hectares (Map 1).

Cyrenaica

855,370 square km. with 451,469 inhabitants (0.52 per square km.), of whom 136,641 are in the city of Benghazi, 143,024 in Benghazi District, 87,162 in Muqataa Jebel Akhdar and 45,197 in the Derna District = 275,383 inhabitants, 80% of whom inhabit 8000 square km. Tobruk District has 38,804 inhabitants, Ajedabya District 44,684, Kufra District 7,482, a total of 90,970 inhabitants. Cultivated land extends to 200,000 hectares, 2,000 of which are irrigated (Benghazi, Barka, Cyrene) and there are c. 4 million hectares of grazing (Map 2).

Fezzan

640,170 square km. with 78,714 inhabitants (0.12 per square km.).

Cultivated land (gardens) totals 2,700 hectares, tree cultivation (date palms) 1,200 hectares, in all about 4,000 hectares of food-producing land together with some 2 million hectares of grazing land.

Libya extends far into the Sahara. Only 9% of the country can expect sufficient precipitation to permit plant growth and it is best described as a desert state.

In the north Libya is contiguous to the Mediterranean. Its coast, aligned on an east-west course, is broken by the broad Gulf of Sirte which projects far into the land, flanked by the Mountains of Jebel Akhdar (875 m.), which protrude from east to north, and by the Tripolitan Jebel (960 m.).

Both mountain ranges are divided up by a line of fractures and slope towards the north. A plain, rising from the sea and widening to 100 km., extends before the Tripolitan Jebel whereas the Jebel Akhdar has but a narrow, intermittently broken coastal strip stretched before it and widening only in the west of the hill country. Owing to their height and extension northward both receive higher rainfall than the surrounding area, with the effect that the otherwise narrow strip of salt-steppe of 30 to 50 km., which follows the coast from Egypt, is broadened. In parts there are still islands of bush-steppe in the hill country, remnants of former stands of trees which were largely destroyed during the last war.

Towards the south the Tripolitanian Jebel grades down to extensive plateaux with stone deserts (Hamada). They persist at heights of about 500 m., the same heights as are gained further to the east by shallow gradations of the Sirte hinterland. Here the low table-shaped elevations surround the gravel areas (serir), sizeable in places, and in parts covered by extensive basalt slabs towards the south, the volcanoes of which rise to heights of 800 m. in the Jebel Sauda and up to 1,200 m. in the Haruj es Sauda.

With these low plateaux and hill ranges, table mountains and volcanic prominences, the total desert has, after a transitional strip with declining vegetation, been reached. The hill ranges and wide, stony, gravel flats are almost without vegetation; the plants, growing poorer, retreat to the wadis. Towards the south wide basins follow which, divided by hill ranges, rise more than 200 to 300 m. in height. Within these extensive stretches of dunes have developed, the so-called Edeyin, accompanied along their margins by rows of oases or monotonous, slightly undulating serir plains delimited towards

the southern Libyan border by higher swells like the Mangeni Plateau (1000 m.) or high mountains like the Tibesti (3400 m.).

In Cyrenaica behind the Jebel Akhdar the heights remain lower and are generally below 200 m. Here the extensive gravelly areas of the Serir Kalansho and the sands of the Libyan Desert advance to within almost 300 km. of the coast. Only on arrival in the vicinity of Kufra do isolated, low hill ranges arise; these reach heights of 700 m. in some cases and even 1,000 m. in the Gilf Kebir on the other side of the border with Egypt. Three small inselberg ranges rise in the south east above the vast plateau (500 m.) near the southern border, the highest of which, the Jebel Uweinat attains 1,934 m. The highest summit in the country is to be found further towards the west on the northern arm of the Tibesti, the Dohone; this is the Pik Bette at 2,200 m.

These extensive areas of gravel and sand, tablelands and hill ranges in the south of the province of Cyrenaica are practically waterless save for a few relatively deep wells, the small oasis districts around Kufra and the wadis in the northern Tibesti and the inselberg ranges. For hundreds of kilometres not a plant can be found and rainfall is seldom experienced and scanty. From the direction of Egypt a wedge of extreme desert extends westward deep into Libyan territory.

At the outset only those areas which could be put to use for cattle herding and the cultivation of useful plants were of interest to man. These were primarily the areas of the two jebels near the coast which together with their immediate environs can be used for the cultivation of grain and arboriculture with the partial assistance of irrigation. The zones of bush and dwarf-bush steppe were left to nomadic cattle breeding which, provided that rainfalls were adequate, could be extended across the northern edge of the full desert towards the south. In such a case a limited amount of rain cultivation is also possible here. In the desert itself, as also in the belt of salt steppe and especially along the coast, oases (i.e. belts of oases) developed in shallow basins and in wadis where groundwater comes near to or actually reaches the surface. Today the most important tree there is the date palm. Beneath it garden cultivation with irrigation takes place. In the desert oases and wells are often far apart from each other. Frequently a whole day's journey was necessary in order to travel from one waterhole to the next.

1. The Regions and Landscapes of Libya

Every country and every continent can be divided into regions which distinguish themselves from their neighbouring regions by the differing characteristics of their scenery. These latter may be due to the geological structure, to the climate, the hydrology or the soil types, or to the flora and fauna. Thus their influence extends to the manner of settlement as well as to the way of life of man. Nevertheless such regions may show similarities and analogies. Regions can be subdivided into component landscapes, i.e. smaller complete units, which in turn are made up of regional components which themselves consist of sub-components of the 1st, 2nd order etc. If a lake were taken as a landscape component for example, it could comprise water areas with and without aquatic plants, small islands with or without tree growth, sand banks, reeds, marshland, alder bog or barren sand beach, the whole constituting a mosaic.

Thus Libya can be divided into steppe regions, desert regions and regions of a transitional character which in turn present sub-groups and sub-components. Since the main intention is to review those regions which are of importance to man, the desert regions are but briefly treated. Likewise of the regional components (the smallest elements) only the most important will be mentioned without special reference in Map No 3.

a) Tripolitania

1. The Jefara Coastal Plain Steppe

In front of the fault scarp of the Tripolitanian Jebel in north west Libya stretches the Jefara coastal plain which is up to 100 km. wide and declines from the edge of the Jebel at a height of 200 to 300 m. towards the sea. Of all the Libyan regions this is the richest in water and fertility and thus also the most densely populated. Marine transgressions in the Quaternary led to the covering of the older sediments of calcareous sandstones and sandstones by recent detritus and course yellow sands which alternate with pebbles from the mountains and loess-like, fine reddish sands blown in from the south. Apart from this there has been a development, chiefly in the west, of crustaceous limestone lying on the surface.

The *Coastal Strip of Oases* (1 a), an average of 10 km. wide, is important because of the development of the country's capital here as well as the most important port on the site of the ancient Oea. The *Tripoli Urban Region* ($1\ a_1$) did not only confine itself to the coastal strip but extended beyond this to the adjoining dune and shrub steppe in the south. The oldest and congested native town of Arabs and Jews with two and three-storeyed houses, is still in parts surrounded by a wall. Its north western part is situated above a cliff some ten metres high (calcareous sandstone overlain by firm loess). Another line of cliffs in front of it is connected by piers and today forms the great port basin. At this point the fort built by Charles V can still be seen forming the eastern pillar of the old town (Fig. 1). The new European town began to grow from here after 1890 and extended to the south and east. It is still of a markedly Italian character; high building is beginning to provide it with appearance of a major city. The cathedral and the governor's palace once served as the town centre but nowadays it is more and more being penetrated by Arabs. New mosques have been built and the governor's palace has become the royal residence. In the south the town is surrounded by a ring of slums near the Megenin Wadi which provide an initial haven for those persons arriving from the hinterland who find no employment. This area is to be cleared and the natives are to be rehoused in proper homes. This town has already expanded along the coast as far as the wadi, has pushed through the belt of the Giorgimpopuli garden city and has even displaced the former Italian farm settlements. The big agricultural experimental station, Sidi Mesri, is, however, still here and the highest annual precipitation totals in Tripolitania (382 mm.) are recorded in the place. The oasis which adjoins the town in the east is also being gradually redeveloped. A network of made-up roads covers the oasis gardens with their palm trees as far as the Mellaha salt pan where salt is worked as well as extending to the airport with the Wheelusfield

township. Individual villas and larger estates of the townspeople lead to the original oasis near Suk el Juma.

The *Coastal Strip of Oases* adjoining the town *in the West* (1 a_2) crosses the Tunisian border in the west. The coastline is generally formed by a low cliff of red clayey sand (loess) which is superimposed on a hard calcareous sandstone. In front of the main cliff there are isolated short lines of cliffs and in the west there is here and there even a low (up to 0.5 m. high), narrow surface of marine abrasion indicative of small tides in the Gulf of the Little Sirte. Here also a sandbar extends westward above a line of reefs and separates the shallow Machbez Lagoon; apart from that there are only isolated low capes (8—10 m.) with limestone cliffs which already harboured port settlements in ancient times (Sabratha, later Zuara et al.) and still continue to offer shelter for fishing vessels today.

Above the cliff a strip of white, yellow — and, towards the interior, brown — dunes extends; it is of varying width and is now largely consolidated by salt plants and in places by a scrub growth of sand pine, cypresses, tamarisks, acacias, robinias and eucalyptus. Behind these and in fact between the dunes begin the sebka. These are seasonally dry salt clay areas or salt swamps if the groundwater table is sufficiently high or a connection with the sea remains. West of Zuara this narrow, frequently interrupted strip of sebka widens to about 50 km. Here the sebka are substantially larger and consist in fact of extensive lakes with surrounding belts of salt beaches. The dune terrain rising to the south initially contains a few, small in-filled sebka with isolated shrubs and palm trees and then gradually changes to dwarfshrub steppe. Towards the east the first palm trees stand between and beside the sebkh and only on their southern side do they coalesce in small (Regdalin et al.) and then extensive palm groves. Villages and small settlements are situated on their fringes, the larger of which continue to resemble small Italian country towns (Agelat, Sorman, es Zavia, Zanzur, 5—10 m.) in their present central areas. In the oases stand the white box-shaped houses of the Arabs and here the *dalus* of the wells, the sources of irrigation for the small fields beneath the palms and the oil and fig tree plantations.

The *Eastern Coastal Strip of Oases* (1 a_3) is one of the most densely settled rural areas of Libya in its section east of Tripoli to a point beyond Tajura. Above the cliff the palm trees soon appear, extending for about 8 km. to the edge of the inland dunes which are planted with bushes and trees. Apart from the large places Suk el Juma and Tajura with a mosque decorated with pillars, there are numerous smaller settlements with fields and wells in the oasis. The water from these latter is mainly raised by motor pumps with a consequent high wastage. The old wells, activated by man or beast — the "dalu" in which water was raised in a goatskin bag on a hoist — were more economic. Vegetables, barley, oats, lupins and fruit trees (date palms, agrumes, fig trees, olives, apricots and almonds) are cultivated. Low loam walls safeguard fruit and gardens against the sand.

The coastal cliff adjoining in the east rises to a height of over 30 m. in places and is broken by steep gorges. Wadis coming from the interior in well-marked valleys here and there dissect the coastal land which, covered by white and reddish-brown dunes, rises gently towards the south. Bush and woodland islands of eucalyptus and thorn bushes protect the top soil from denudation. Only at some distance from the sea near Garabulli do the extensive olive plantations with fields between the trees commence. They can be irrigated by spray nozzles attached to moveable piping fed from high cisterns. The hilly mountain foreland of the Tripolitanian Jebel gradually pushes further and further towards the sea, thus narrowing the sandy coastal strip of bush. Only the wadi valleys contain small cultivated areas at their point of exit from the foothills.

Behind the strip of oases a *Sandy Bush and Dwarf-shrub Steppe* with limestone crusts gradually rises *in the west* (1 b_1). This dune terrain carries a sparse vegetation of low bushes, herbs and grasses and is to all intents unsettled. One encounters no more than a few rude huts.

Entire lines of dunes, however, are barren and shift across those dunes which are fixed by vegetation, and across the shallow depressions; frequently a hard, brown sub-stratum is unearthed. The steppe rises in long shallow waves towards the south. Where somewhat higher ridges occur, dividing extensive flat plains, limestone (limestone crust) covered by coarse stones comes to the surface. Blown-sand overlies the limestone and shifting dunes migrate across the ridges. Even between the coarse sand areas of the plains on which dwarf shrubs, thorn thickets and esparto grass grow, barren limestone expanses occur again and again as well as remnants of the hard, brown clay soil the surface of which is furrowed by sand abrasion. Scattered over the plains are found isolated cement wells and cisterns containing brackish water which is, however, sufficient to supply herds of sheep and goats — at times several hundred in number — which are guarded by strong, white watch-dogs. Very occasionally one may even see a single camel grazing on the poor dwarf-bush steppe. In the neighbourhood of some important Uotia wells the Italians had erected small forts, the remnants of which are still used by nomads who generally live in temporary settlements of straw and branch huts or sometimes in tents.

Towards the south the *Western Gravel Foreland of the Tripolitanian Jebel,* which is situated in front of the escarpment, continues as far as the *Menshar Hills* (1 d_1) in the east. The gravel foreland attaining a breadth of up to 25 km. falls away towards the dwarf-shrub steppe (in the north) by way of a low scarp which in places merges with it. In parts it is more deeply dissected by the valleys of wadis which descend from the *Jebel Escarpment* (2 a_1). The slopes of the dry beds show that the almost wholly sterile gravels are superficially adhering to limestone crusts (1—1½ m.). Their soils, covered by sand and brown loess, carry a vegetation of bush and grass; at times nomads have cultivated fields (rain agriculture). After a short course the wadis lose their way in the dwarf-shrub steppe.

At particular points of the gravel margin the underground water-table (spring-line) is tapped. The sweet water, which surfaces here, at times leads to the formation of quite extensive spring-line swamps with rushes, reeds and tamarisks and has led to the establishment of oases. The water was brought through ditches to the gardens, fields and tree plantations. At times of high water levels and after ample rainfall, further swamps formed and acted as breeding places for malaria. The lining of springs, the collection of water in cisterns and the clearance of channels improved the sanitation of these areas as well as those of the villages situated on the gravel slope above the oasis (Tigi (Tishe), Dshonosh,

Shekshuk et. al.) and the sweet water wells in the swamps (e.g. the one below Nalut).

The Menshar Hills consist of Mesozoic (Triassic, Jurassic) sandstones, clays and gypsum. They start at the Jebel Scarp, protrude far to the north and terminate the western gravel fields in the Jefren Heights. They are much dissected and split up into bad-land hills. Where gypsum occurs they are bereft of vegetation and in other places they carry a very sparse dwarf bush vegetation.

Just as in the west there is a gently rolling area of brownish-yellow, loess-like soil in the south of the city and oasis of Tripoli which is overlain by dunes; in places these are at present fixed by low bushes and grasses. This is the most important *Settlement Area South of Tripoli* (1 c) and extends to Suani ben Adem and the airport (Idris) and from there grew beyond Azizia and further west to Bianchi (Azzahra, south east of Zavia). The dunes reached approximately as far as Ben Gashir where they give way to a gently undulating area occupied by low dwarf-shrub clumps, easily to be levelled out. Larger farming enterprises have been opened up along the road; wind motors (motor pumps today) raised groundwater chiefly from the secondary horizon; cisterns which are located above serve to irrigate the tree plantations which are generally laid out in widely-spaced rows interspersed with fields. Eucalyptus trees grow in rows along the roads and fields which are protected from the strongest winds, i. e. the N.E. and S. winds, by hedges composed of bushes, acacia, tamarisks and at times even opuntias. From the 48 metre-high Azizia inselberg (158 m.) an extensive view may be had across this settlement district; towards the north and west it gives an impression of a wide strip of cultivation in the steppe. Although the winter rains at Azizia are on average small, relatively thick morning mists can be relied upon here in the transitional seasons (Fig. 2).

Only towards the west does the countryside, which is studded with tree plantations (olive trees, figs, almonds, castor oil trees etc.), become broken; towards the east dispersed bush may be recognized on the dunes. South of Azizia the steppe is still worked with a shallow plough and prepared for rain cultivation. The hummocks of fine brown sand up to a meter high once scattered around and clothed with wide branching, thorny Ziziphus bushes, have largely disappeared. The intention was to extend the settlement area towards the west and particularly between Bianchi and Suani ben Adem (the Bir el Ghnem project); two smaller areas with farmsteads have already been opened up. Water for irrigation was to brought along from the Bir el Ghnem at the foot of the Menshar Hills. Unfortunately it was discovered that excessive removal of the water would constitute a danger to the supplies for Tripoli and the project was postponed. A second settlement project is that of the Meginin Wadi in the south east of Azizia. The wadi which often carries ample water, is tapped several times in the west, the water then dammed, divided off and led across the settlement area. At the same time it is hoped to achieve a rise in the groundwater through this damming and diverting.

Further down, between the Idris airport and Tripoli, the wadi Megenin is now canalised and led on between steep banks of 5 to 10 metres as a result of high water levels having made extensive areas — particularly around Ain Zara — swampy. This area has now been reclaimed by drainage and the threat of malaria averted. However, an over-sharp bend towards the west south of the Castel Verde suburb has caused floodwaters to break through at that point and to threaten the suburb as well as the slums mentioned above.

In the *Eastern, Sandy Steppe* (1 b_2) beginning south of the belt of oases, the dunes are mostly fixed by indigenous bushes, shrubs and grasses, even if great quantities of sand are transported by the winds. Towards the south the dunes decline and east of the Megenin they change into dwarf-shrub steppes which serve the nomads of Tarhuna as summer grazing. As the Jebel fringe usually receives more plentiful rains in winter and spring, the wadis in the foreland can still fill relatively numerous cisterns which last through the summer. As the Jebel swings towards the north east the dwarf-shrub steppe, which merges into gravel fields towards the south as it did in the west, narrows gradually and together with them changes to foot hills.

The *Eastern Gravel Foreland of the Jebel* (1 d_2) is generally narrower than the one in the west but broadens, however, in front of the deep clefts of the mountain edge and between the inselberge which lie in front of the Tarhuna Jebel and as far as the Azizia inselberg (Triassic, Jurassic). The Batus reach a height of 326 m. The hills are barren for the main part; in rock niches and crevasses a few thorny dwarf shrubs and cushion plants grow on loess-like soil. Only at their foot is there the commencement of some cultivation with water from the Megenin wadi (see above). Towards the north west the narrow gravel fields merge with the dwarf-shrub steppes and the hilly foreland of the Msellata. The wadis are in parts deeply incised and dissect the hills into long interfluves. In the valleys having bush slopes some dry farming is practiced in isolated places and here and there are a few indigenous trees as well as palms to be found. Herds of small stock, the tents of nomads and cisterns can be seen more often.

2. *The Tripolitanian Jebel*

The western Tripolitanian Jebel (Jebel Nefusa) runs fairly straight from the Tunisian borders in the west for about 180 km. to the east to the Menshar Hills which jut northward and are limited by the Kikla Trough on their eastern side. Here the Jebel gradually swings towards the north east and is then traversed by a number of faults along a north west/south east trend which experienced volcanic eruptions from the post-Eocene to the Quaternary and the extrusion of phonolites and basalts. The Jebel terminates 150 km. west at Homs on the sea.

The *Hilly High Plains-Steppe* (2 a), reaching a height of 600 m. near the watershed *in the west* and 800 m. in the east, average 20—25 km. in width and towards Jefara fall down steep escarpments which have a relative height of about 400 m. in the west and of about 500 m. in the east.

The *Northern Escarpment* (2 a_1) made up of limestones, dolomites, marls and clays of Cretaceous and Jurassic age, is dissected by short dry valleys some of which terminate in circular niches and some of which recede in steeply incised canyons which rise stair-like until they end in broad basins or depressions on the plateau. The steep slopes of the wadis as well as the spurs protruding into the plain are even more split up by the alternation of harder and softer rocks. Often three or even four steps can be identified, partly covered by

broad flows of detritus marked by rills and ravines. The valley floors are filled by detritus and brown loess-like soil which alternate with one another, and the periodically flowing wadis have cut steep courses into them. Only here and there can a few bushes be noticed in the stone desert. In these spots, however, where loess soil has been deposited at the talus foot of the slopes, the inhabitants have laid out terraced fields which mount the hill like steps and gradually decrease in size between ravines and small detritus ridges. Towards the plain the wadi valleys broaden out and merge with the gravel foreland of the Jefara.

Above the steep slope the *High Plains-Steppe with low bush and dwarf-shrub vegetation* commences (2 a_2) and rises further towards the watershed in a series of cuestas. The hill country with its depressions and basins is overlain by loess-like, reddish brown soil between which light-coloured limestone (upper Cretaceous), strewn with stones, is prominent, particularly so on shallow slopes. Dwarf shrubs and grasses extend as far as the heights of the watershed, from whence the land slopes gradually down towards the south. In the springtime the rain and mist cause a prolific herbage to spring up for the herds of sheep and goats. The fertile soil of the but little incised wadis of the shallow depressions benefits particularly. These wadis are spanned by low dams which collect the water for the few olive and fig trees. At the same time a few fields have been laid out here. Tree growth becomes lusher with even isolated palm trees, towards the edge of the plateau — as far as for instance the Rumia Gorge above Jefren (715 m.) where some water seeps into swamps and pools from which artificial terrace fields on the slopes are also irrigated. At different points of the steppe afforestation experiments have been carried out with Mediterranean bush and plantations of olives. The villages of the plateau prefer sheltered positions and particularly those on protruding spurs (Jefren, Jado, Nalut) although they have, however, been abandoned because of their inconvenience and the deterioration of the houses. Close by new and more open settlement is growing up where — as in the case of Jefren — government, business people, the military as well as a hospital, have established themselves. At Zintan and Nalut the cave dwellings of the Berbers may be seen (see below and Fig. 3).

Beyond the watershed the *Dwarf-shrub Steppe of the Southern High Plains* (2 b) becomes poorer. The great steppe wadis like the Wadi Soffedshin with its tributaries extend far back. They have created long, broad interfluves with hardly any vegetation save spiked cushion growth on their barren stony heights. The low bush vegetation withdraws entirely to the valleys and forms low, slightly sinuating strips of bush on the flat, stony valley bottoms. Isolated wells serve the nomads as watering points for their animals, although many contain only brackish water. This is especially in the 500—600 m. high foreland (Cretaceous) into which the interfluves drop in shallow steps. On the stony and sandy areas between them, dune fields drift towards the slopes of the hamada in the south west.

The *High Plain of the Eastern Jebel* (2 c) commence at the Kikla Trough. They swing towards the north east. This 20 km. long and 5 km. wide trench was formed by faults; the *Jebel Escarpments* (2 c_1) rise steeply along them. Their foot is covered by steep gravel slopes, which are in turn overlain by loess layers washed or blown there, leading through to the flat bottom of the trench. The watercourses which periodically pour down from the slopes above have worn steep gullies and gorges into them; they coalesce in the Wadi Ghan which has itself cut down to the gravel sub-surface. The trough rises in several scarps towards the plateau. At about half the height of the valleys which come down from above there are isolated small oases which are associated with springs.

Below Garian only short valleys cut back into the slope, some of them having small irrigated terraces in their upper courses. Parts of the valley of Bu Gheilan have been successfully afforested. The wadis soon lose themselves in the gravel fields of the Jefara and only the Wadi Hira can be traced beyond Azizia. East of the inselberge (see above) the Wadi Megenin follows and this, together with its tributaries, extends far into the high plain. The slopes then become lower and less steep. Wadi valleys which even extend as far as the sea in the north east, have dissected the outer high plain into a knolly hill country which takes the place of the escarpments towards the end of the Jebel.

Above the steep slopes there are larger oases at the edge of the rising *Bush and Dwarf-shrub Steppe High Plains* (2 c_2), an example being the Garian Oasis which is surrounded by a circle of smaller villages. The bedrock limestone is buried beneath several metres of fertile, loess-like soil into which chiefly along shallow slopes near villages the natives have dug their cave dwellings. A winding passage leads to a deeply situated courtyard, some 4 to 5 metres down, from which the living quarters have been dug into the harder limestone-loess or even gypsum-marl. Above these a limestone crust is frequently found, followed by a firm, reddish-brown loess (2—3 m.). Old olive and fig trees as well as acacias often stand between the cave shafts and around the villages. On the fields, especially those of the former Italian settlement of Tegrinna, great quantities of tobacco are grown as well as olives, legumes and barley. Large communal and smaller privately-owned cisterns collect the rain and provide water for the population and their cattle.

A new element in the landscape is manifested by the volcanic rocks along the faults near the eastern edge of the Kikla Trough. North of Garian rises the barren grey tuff crater of the Tekut volcano (phonolite, 724 m.) and west of it intrusions occur which stand out darkly against the surrounding limestone. South of Garian an extensive *Basalt Area* (2 e) — of about 3,000 square km. — is reached, and this rises gradually to a height of 968 m., sending out long lava streams, especially towards the south, the longest of which can be followed to a point beyond Beni Ulid. In the vicinity of the large lava area are further smaller volcanoes (like the Tuil Said in the west) as well as intrusions as far afield as the surroundings of Misda (Phonolites and porphyries).

The Megenin Wadi with its large catchment area deeply penetrates the basalt area. Its western part is being afforested (the Wadi Huelfa Forest), the Wadi Jamal will become a forest reserve and the southern part of the catchment area, which contains numerous wells, is left to the nomads.

In the smaller, ramifying valleys of the *high plain* (2 c_2) as well, the stony slopes of which support only poor, dwarf-shrub steppe, isolated areas are being surrounded by stone walls and undergoing afforestation. Denser bush growth stands out against the grey steppe with the occasional nomad's hut. Owing to the dissection

of the high plain from both sides, a sort of hilly high-valley has been created between higher peaks from Tarhuna to beyond Cussabat, in which the watershed shifts to and fro. The limestone hills are partially barren and mantled by detritus and partly overgrown by dwarf and bush steppe; the loess-shrouded and often deeply furrowed valley floors in particular support olive tree plantations and fields. The very many small farmers take their olives to mills where the oil is mechanically processed. Plantations can be traced back to ancient times as far as beyond Cussabat, when this area was already rich in oil. West of Homs begins the hilly slope to the narrow edge of the beach which is covered by Mediterranean shrubs and small forests of pine trees.

The *Low Bush and Dwarf-shrub Steppe of the Southern High Plains* (2 d) is dissected by long wadi valleys which turn first from the northern and then also from the south western and western direction towards the Wadi Soffedshin and the Sebka of Tauorga. In the northern parts close to the sea the wadis bend from their westerly direction towards the coast in the north.

Already less than 20 km. south of Garian the catchment area of the Wadi Tfelgu is reached. Extensive and densely overgrown basins into which lengthy lava streams have been discharged by volcanoes, draw together the dry valleys and then as a narrower valley breaks through the steep scarp of a limestone table already much dissected by side valleys. The dwarf-shrub vegetation which often consists of nothing but camel thorn on the low hummocks, retreats entirely from the valley slopes to the wadis; every now and then, however, there are small groves of old, gnarled olive trees on the extensions. On the dissected, desert-like tableland and interfluve country of the Dahar which falls away in shallow scarps towards the south and south east the above mentioned wadi, as well as the succeeding wadis as far as the Mimun Wadi, which are effected by lava streams and themselves rich in wells and cisterns, pursue their courses to the Wadi Soffedshin. Worthy of notice is the Beni Ulid wadi whose slopes fall steeply to a canyon-like valley which contains a fertile oasis, concerned predominantly with olive cultivation, some 20 km. in length. After the stronger rains of winter a long lake often forms in the oasis and this may persist for several months. The villages of white limestone are situated at the valley edge, or, as in the case of Beni Ulid, on the basalt of a lava stream above the valley, with the effect that the bright green oasis in the desolate, greyish-white and stony limestones can be seen from far off. Here too the interfluves decline in shallow steps to the east and terminate in the outliers in the bush and dwarf-shrub flats on the Wadi Soffedshin.

Starting in the north eastern part of the plateau known as the Msellata, the Lebda, Tareglat-Caam and Mager wadis pursue their courses across the sloping steppe hill country towards the sea. The Tareglat-Caam wadi contains a number of springs, the water of which has been dammed for irrigation purposes. On several occasions high water has broken through these dams. This wadi is the only perennial one in Tripolitania for even in summer there is a thin line of water flowing in it.

These wadis also traverse the 15 km. wide *Coastal Oases strip between Homs and Misurata* (2 f). On both sides of Homs stretch date palm groves, gardens, fields and fruit tree plantations; together with the plantations of Cussabat and Sugh el Chmis they form a large area of cultivation. The little town of Homs is situated on a protruding hill which falls gradually towards the sea. Homs is the successor to Leptis Magna which lies 5 km. further east and its relatively well maintained site of ruins from Roman times gives a good insight into the culture of that time. The old site was buried by sediments of the Lebda wadi as well as dunes with the result that much of it was preserved. It received its water supplies by way of an aqueduct from the 25 km.-distant Caam-Tareglat wadi. Remnants of the old Roman dam and aqueduct are still preserved. At the present time dune terrain above a cliff separates the oases mentioned above from the Zlitin Oases with their 200,000 palms. Overtopping the low houses of the settlement is a sanctuary, the mosque of Sidi Abdassalam. Palm trees and plantations extend close to the cliff. The oasis itself contains only wells with brackish water; east of it there follows a gently undulating terrain, consisting in part of shallow sands, interrupted by acacias and thorn bushes, and in part of high sterile dunes. The grass and dwarf-shrub areas appear again and frequently extend towards the barren limestone hills in the south, some of which are crowned by a marabut. A few kilometres before one reaches Misurata there are large olive plantations which continue as far as the great palm oasis. Apart from the little market town of Misurata there are a number of villages scattered throughout the oasis as far as the Marina in the east where the branches of the great Tauorga Sebka come to an end. In the north the oasis is bounded by dunes which commence above the cliff (Cape Misurata); in the south it merges with the settlement area of the Tamina Oasis.

3. The Hamada el Hamra

The Paleocene limestone table of the Hamada lies everywhere on Cretaceous limestones towards which it falls in sometimes higher and sometimes lower steep scarps. The forelands which consist of chalk are lower and largely dissected into a hilly country.

From the north an 80 to 100 metre high scarp with broad bays and narrow notches leads up to the wide *Limestone Plateau of the Hamada el Hamra with its Spring Pastures* (3 a). In the wadis there is at times sweet water which comes from the blue-grey marl strata lying above red clay. A few bushes grow in the sandy wadis. Thick banks of limestone and dolomite, in which have been found caves with rock drawing and Koranic verses, form the bedrock of the plateau and blocks of limestone and coarse detritus the slopes.

The limestone plateaus themselves are slightly undulating. The eye wanders across unending, stony, almost barren plains. The surface of the limestones is coated by a reddish-brown to black crust; fine reddish soil has been blown against them; gusts of wind blow the brown soil into eddies.

Thus totally sterile areas alternate with these and support small plants, 2 to 3 cm. high hidden among stones and with yet another type which support scattered dwarf bushes. Narrow sandy wadis shallowly etched into the surface, descend from low swellings in the soil. Some parts of the Hamada give a rather flecked impression since rain pans of small diameter (up to ca. 50 m.) are impressed on it; they support a poor vegetation on their enriched soil. Here birds, hares, gerbils, ants and even occasional snakes may be encountered. Thus the Hamada in general presents a drab aspect although after the spring rains it is transformed into a green, flower-

strewn carpet. At this time the herds of the nomads also appear since, apart from the lusher vegetation there are also wells and tmeds as far as the southern edge in some of the larger, closed, steeply-walled basins or in blind wadis. The basins presumably formed as collapsed dolines, particularly as there are very many marl and gypsum lenses distributed in the limestone. Wadis in like manner end up in the basin, having deposited brown soils which crack into polygons during dry periods and carry a cover of salt after rains. At the edge of the terminal pans the soil is often strewn with gypsum crystals. In addition some higher 50—80 m. scarps are orientated east to west cross the Hamada and these correspond to the older obliterated strata.

The escarpment of the Hamada (150 m.) which apparently follows a tectonic line (north west — south east) is breached from the east by the larger tributary wadis of the Soffedshin and Zemzem, by these themselves and by the Bei el Kebir wadi. They embay the escarpment with broad valleys of which the northern ones in particular still boast plentiful dwarf-shrub vegetation. The valleys on the plateau begin as lines of rain pans, at first small and then larger with diameters of 200 to 300 m. and up to 30 cm. deep in water after rains. Between the larger of these there are at times connections and the joining of several pans leads to the formation of a watercourse which descends by way of a circular scarp into a valley which soon widens and deepens. The catchment area of the Wadi Zemzem is the area richest in water and vegetation; it contains several small oases which belong to nomadic tribes who also cultivate fields in the wadis. Gheriat el Garbia is the largest oasis and its palm groves and gardens are situated in the valley below the settlement (Fig. 54). Numerous remains of ancient buildings (Fig. 55) indicate that already in Roman times it was fortified and of a certain importance. The other oases are smaller and the more southerly situated of the border wadis lack them altogether.

At the southern edge which is dissected by short wadis, Jurassic and Palaeozoic strata outcrop below the Paleocene and Cretaceous chalks which are found in the Gargaf Jebel and far into the Edeyin. The western edge falls in two divergent and embayed scarps towards the Gadames foreland. In the south of this foreland the Hamada el Hamra gradually merges into the similar *Hamada Tinghert* (3 b), the limestones, dolomites, marls and gypsums of which derive from the Senon (Cretaceous). The broad wadi valleys passing back from the north to the Hamadet, carry prolific dwarf-shrub vegetation in their winding beds and these form nomads' country.

Most of the wadi valleys lose themselves in the terminal pans at the fringe of the sand desert east of the Erg or form grey gypsum pans like the great Mzezzem Pan or that of Gadames. Apart from that the *Western Foreland of the Hamada* (3 c) is a total desert with a few oases near the steep rim. The interfluves which flatten out at their ends between the wadis, are in certain parts covered with coarse limestones; others are serir plains which fan out broadly and are covered by shifting dunes. The Gadames Oasis enjoys an artesian spring in its Ain el Fras (Spring of the Mare), the waters of which have served to irrigate the gardens since ancient times. A few more have been bored recently and the irrigated area of the oasis has thus been increased. Taken together, the narrow lanes between the garden walls, the water ditches, the old slave market and the three-storeyed houses partly built over the lanes combine to give a good picture of the old prosperous oasis (Fig. 21).

Dersh and a few smaller oases are situated near the great Tenarut wadi. Then, after monotonous dunes, sand and grey-stone areas succeed the little oasis of Sinauen in the north; there is an old fort on a precipice of the Hamada in the neighbourhood.

The *Eastern Foreland of the Hamada* (3 d) stretches essentially from Gheriat es Schergia and the escarpment of the Hamada there to the trough of Hon and the Jebel Sauda in the south. Several large wadis — the Bei el Kabir wadi, the Rawawus wadi and the Ghirza wadi with its tributary wadis — have dissected the limestones and dolomites into a 250—350 m. high stony hill and table country, the barren scree slopes of which are traversed by steep ravines. Numerous wells and springs as well as dwarf-shrub and herb vegetation in the wadis and basins make it valuable for nomads. A great number of dry beds turns towards the north east in the Hon Trough which is reached by way of a terraced escarpment of between 50 and 100 m.

4. The Western Sirteland as far as el Agheila

The western Sirteland stretches from the Hamada el Hamra and its foreland approximately to the border of Cyrenaica at Agheila on the southern bay of the Great Sirte. Its rocks which are largely of the Tertiary (Palaeocene to Miocene) are traversed and broken by faults running from north west to south east, thus causing the formation of several troughs and in particular than of Hon. The land falls north eastward from a general height of 400 m. (Jebel Waddan, 650 m.) to sea level.

A *Limestone Tableland* (4 a) also consisting of Creataceous limestones and *traversed by Faults,* protrudes like a bay from the east towards the Hamada el Hamra (see above, 3 a). The table is crossed by two larger wadi valleys, the Soffedshin and Zemzem, both of which meander in great sinuations towards the Tauorga Sebka. They contain numerous and mainly smaller tributary valleys which have helped to dissect the country into larger and smaller tables. The Soffedshin wadi comes from the southern Nefusa Jebel, runs past the little oasis of Misda and winds itself across a stony and sterile valley bottom across which dune fields migrate, in a broad bed. These even frequently cover the bed of the wadi which is overgrown by bushes and shrubs and supports the occasional acacia or other groups of trees. Here fields (barley and millet) have been laid out by the nomads whose tents and herds may be encountered at times. Remains of derelict Roman or even Byzantine buildings, villages and single farmsteads may be frequently seen. Just like derelict monasteries and other church buildings, they generally stood in a sheltered position on the fringe of the rock-strewn table areas. In the valleys old cisterns and wells occur frequently. The former are mostly so well kept that they are still in use at the present time. Only surplus water running through was used for irrigation. The ancient Roman settlement of Ghirza with buildings adorned with columns, was, like the Misda Oasis, an important strongpoint in the former settlement area which becomes increasingly low and open towards the east with the effect that the broad wadi beds are scarcely to be discerned. The Bu el Gheddahia Fort

on one of the last low hills above the Zemzem Wadi with a view across the wide low bush and shrub steppes, has always been an important strongpoint (Fig. 5).

South of Misurata stretches the *Tauorga Sebka* (4 b_1) with a length of 110 km. and a median width of 30 km. A dune sand bar, interrupted at a few narrow points, separates it from the sea. Apart from the Soffedshin and Zemzem wadis, a few smaller wadis discharge into it. They originate on the eastern slopes of the Tarhuna Jebel; water has been drilled in their lower courses. Subsurface water from both the large wadis comes to light in giant springs in the sebka and forms small lakes which discharge sweet water which runs river-like across the salt-swamp areas, with their salt bushes and saline efflorescence, towards the sea. Between the salt swamps there are higher sand islands, some of which carry palm trees and other salt plants. On the islands stand small villages and the ponds of the Negro population settled years ago in these parts; they also form the majority of the inhabitants of the Tauorga Oasis on the edge of the sebka. Its position is not unhealthy, but a great part of the population leaves the sebka for work, returning only for the date harvest (Fig. 4).

A *Flat Plain with low Bush-steppe* (4 b_2), its brown soil densely overgrown by shrub, extends between the sebka and the hill country which peters out to the westward (see above, 2 d) and broadens out towards the south. As a continuation from Misurata, the Italians cleared and settled the land and the steppe was covered by fields and tree plantations which are irrigated from cemented ditches. The water comes from surface wells and a few artesian wells which are probably supplied from the mountains. The Tamina (formerly Crispi) and Kararim (Gioda) oases are now worked by Arab and Italian farmers. The steppe which adjoins in the south is also to be cultivated; it is to receive its water from the giant springs of the sebkh and from the mountain wadis.

Adjoining the eastern foreland of the Hamada (see above, 3 c) follows the *Tertiary Fault Areas of Trough and Hill Country* (4 c). The *Hon Trough* (4 c_1) (Jofra Trough) runs north west to south east, is 210 km. long and 25 km. wide and subsided in the limestones and chalky marls of the Lower Eocene. Its soil contains Tertiary terrestrial sediments and even marine limestones and gypsum in extensive deposits. In the trough a few large tabular horsts (20—50 m.) have been left standing; dune fields flank them after shifting across the tables and troughs. Wadis end in small basins in salt pans which contain water for a short while after rains. The eastern fringe is accompanied by some longer wadis with broader strips of bush and occasional acacia. There are three smaller oases in the south towards the edge of the Jebel Sauda: Waddan with a big fort, the oasis of which was crossed by dunes in 1962, then Hon and finally the ancient walled-in town of Socna. Large gypsum pans extend north of the oasis line. Brackish artesian water served the population as drinking water and for irrigation purposes. In 1964 a sweet water spring was drilled south of Socna, the output of which suffices to supply all three of the oases.

In the northern part low hill country obscures the line of the trough. Possibly it continues in faults further to the north. The limestone table and hill country is traversed by the broad Wadi Bei el Kebir. At its northern end there is the small Bu Ngem oasis with an ancient Roman fortification on its eastern edge. Numerous nomads pitch their tents in the environs of the settlement.

The 650 m. high *Jebel Waddan* (4 c_2) (lower Eocene) breaks down in several scarps to the southern east margin of the trough (Waddan 250 m.). Only in its wadis does the barren mountain range carry any vegetation; it falls sharply to the north so that the rim of the trough becomes indistinct in places and loses height (about 50 to 80 m. near Bu Ngem). The eastern slope of the range has broader, shallower steps although it still shows a distinct scarp towards the foreland (middle Eocene). Towards the east its wadis become longer, broader and richer in vegetation.

Eocene and Oligocene limestones and the Miocene limestones, calcareous limestones and sandstones adjoining the former towards the north east, form the *Western Limestone Sirte Plateau* (4 d) as far as the Tripolitanian border of Cyrenaica and towards the south as far as the Haruj es Sauda. It is broken up by numerous faults so that trough-like depressions have been formed in parts. In height the barren tables and hills fluctuate between 200 and 300 m. and decline towards the coast to form a hill country which disintegrates between the broad wadi furrows. Furrows, troughs and basins contain extensive bush and shrub pastures and even sebkh with halophile plants; in the lower parts of these the wadis terminate. There are sufficient wells and water holes. The largest oasis of that Zella region is situated in the far south in a shallow basin near the Haruj edge, the old village on a hill crowned by a fort. It is surrounded by a wide circle of palm groves and irrigated gardens. A great number of semi-nomadic inhabitants as well as their herds, remain in the northern wadis in order to till their fields there after the first rains in autumn. North of Zella rich oilfields have been opened up (Mabruk, Dahra and Hofra) over recent years.

In front of the limestone hill country there is the *Western Sirte Quarternary Coastal Strip of Steppe Country* (4 e) of a variable width which extends from the small Buerat settlement to the sebkh of Agheila in the east and is overtopped by isolated limestone hills. Bush and dwarf-shrub cover the land behind the line of dunes which protects the small coastal sebkh from the sea. Wadis from the interior, often recognizeable only by their lusher strips of bush vegetation, terminate here in these sebkh. The often sandy Bei el Kebir, with an extensive sebka along the coast east of Buerat, is the largest wadi. Particularly in spring but in summer as well, the coastal plains offer sufficient pasture for the herds of the nomads. The wells have water throughout the year.

The largest oasis at the coast is the small market town of Sirte built on a small eminence above the cliff. The palm grove lies in the valley of a small wadi, the mouth of which has been developed as a harbour for coastal vessels. Apart from that there are only small settlements along the coast road, each numbering but a few houses with shops, cafés and stores for the nomads; there may even be a school or sick bay.

Both the oil ports of Es Sider and Ras Lanuf gained in importance as pipelines lead from them to the oilfields in the interior. Here oil tanks and refineries have been constructed next to a town built for the employees and Arab personnel. Not far from Lanuf stands the "Marble Arch", now marking the ancient border between Tripolitania and Cyrenaica. Below this runs the asphalt coast road, the link between Tunis and Alexandria.

b) Fezzan

5. The Basalt Extrusion Area of the Jebel Sauda

South of the Hon Trough and the hilly foreland of the Hamada on a base of limestone, marl and clay slate (upper Cretaceous) there is the area of the Basalt outflow of the Jebel Sauda. The highest summit is the Gleb Wergan (803 m.), from which basaltic lava streams emanate and flow in all directions, joining with stream from adjacent volcanoes; then there is a change to vast areas (400—500 m.) covered with rough basalt blocks, again by volcanoes with associated lava flows in their neighbourhood. Wadi valleys originate in the central basalt area and the individual mountains; their slopes are strewn with coarse blocks, but their sandy valley soils support vegetation. In their upper courses plants grow particularly thickly in spring where the heights have been covered for days at a stretch by snow during the winter and the rains have been more generous. Tracks indicate that the area is then visited by numerous nomads. Towards the west the area breaks down into individual plateau, pushed to the fore. Towards the north it falls more steeply together with the basement where large "grarets" have sunk in near the slope: — i. e. depressions with vegetation which often simultaneously mark the wadi terminations. Towards the south isolated limestone tables free of basalt extend further and fall by way of steep scarps, as for instance at the Gaf el Garbi; towards the east there are, however, large basalt flows with larger wadis, gathered into the broad Wadi Agheib which is covered with some shrub and bush vegetation as well as isolated acacias, running between them.

6. The Paleocene Sandstone Hill Country of the Gargaf

South of the Hamada el Hamra and the Jebel es Sauda the most ancient rocks (Cambro-Ordovician) outcrop to form *Sandstone Plateau* (6 a) with table mountains above them. In the east the *Mountain Country of the Jebel Fezzan* (6 b) rises to a row of higher peaks (Nab el Geru), in the core of which pre-Cambrian rocks (gneiss and crystalline slates) can be found. These are said to reach heights of 1,500 m. These highest areas of the Gargaf fall away eastward to a mountain and hill country with depressions and single hills which is overlain by low limestone plateau towards the south east. Towards the west the plateau decline to isolated, low, parallel hill ranges (Ordovician). Towards the south a steep scarp (ca. 50 m.) leads down to a broader area of denudation terraces (Devonian) which slope towards the Wadi es Shati (Carboniferous). On these denudation terraces there is a *String of Oases* (6 c) with ample water and wells situated in the small wadis which descend from the plateau. Around Brak where the steps are wider and the Zigza and Hamuda wadis descend from the higher mountain country, the oases are more numerous. Here there is a number of aquifers and artesian wells, from which water is led for irrigation purposes to the oases. During the occupation period the French opened up further artesian wells with the effect that with too much water which grew stagnant and caused some of the oases to become boggy and saline. The closing of all but a few wells normalized the run-off and the consumption of water once more. Often semi-nomads occupy the small surrounding oases and these people who own the palm trees often, amongst other things, breed beautiful camels (e. g. Gira). As they boast a prolific growth of acacia and dwarf bushes, the wadis which descend from the more humid mountain country are sought out every year by the nomads. Thus enclosures for sheep and goats as well as stone walls are often encountered in sheltered places, the walls being used for the support of tent covers.

7. The Edeyin Ubari Dune Desert Depression

The Edeyin Ubari depression stretches from the steep scarp of the Hamada el Hamra and the southern edge of the Gargaf to the steep slope of the Hamadet Murzuk—Serir Um Alla (middle Nubian sandstone) in the south. It reaches a maximum extension in the west where it is about 200 km. across. Its western part is split and constricted by *the Hamada Limestone Plateau* (7 c) which protrudes roughly in its middle from the Algerian border towards the east. On a line linking Edri with Larocu the depression is narrowed down to about 100 km. by the projecting heights of Gargaf. From here it runs out towards the Wadi Kneir. The largest part of the depression is occupied by *the Ubari Sand Desert* (7 a). Its high dune ridges generally maintain a N.E. to S.W. direction and surge against the northern edge of the Zegher limestone table. Towards the S.W. the dunes grow lower and run out at the Irauen Wadi against the Tassili heights. Along the northern edge of the depression there are small isolated hatiets (depressions with bushes and grass) together with wells as well as some vegetation and Tmed (blocked water-holding indentations) in some of the oval-shaped basins between the dunes. Near one of these, the Hasi Atschan, on the northern edge of the Zegher limestone table, oil has been found (an outlier of the Algerian Etsheleh field).

In the *Eastern Part of the Edeyin, the Ramlet Zellaf* (7 b) the dunes follow an approximately east to west direction; between the long ranges of dunes there are basins, divided off by low transverse dunes. The northern edge of the sand desert is accompanied by the es Shati and Zellaf wadis which both approach from the east. Both are cut into Carboniferous limestone which between the wadis are overlain solely by a thin cover of stone and sand and a few low dunes. The Zellaf wadi roughly follows the deepest sections of the Ramlet (450 m.). Some 100,000 palm trees, irregularly distributed over its course, grow in it and generally belong to nomads. With the Wadi es Shati it comes to an end in an elongated sebka west of the small village of Edri established on a well-watered palm grove. The surface of the sebka is broken into erect salt blocks, displaced against one another and difficult to traverse. South of the Zellaf Wadi remnants of wadis, infilled by dunes, are frequently to be found. Thus small groundwater lakes like those of Mandara, Trona and others have developed at some points along the southern fringe, their beaches at times covered by palm trees. They are followed by irrigated gardens and shrub thicket and bushes; the "Seribs" of the inhabitants (Dauada) are situated on the neighbouring dune slopes. Towards the east the dunes frequently form shorter but not easily traversed ranges which migrate over rough hard sands in shallow ripples. Towards the es Shati wadi with its sporadic palm groves, shifting dunes in the Wadi Kneir have formed higher and complete dunes here in recent years with the effect that the crossing of the Ramlet becomes more and more difficult.

On the southern edge of the sandy desert between the latter and the steep, ragged limestone slopes of the Hamadet Murzuk (150—200 m.) and the Serir Um Alla (60—100 m.) there is the *Wadi Adshal* (7 d_1), 5—6 km. broad, with rows of oases from Ubari to el Abiad (150 km.). Palm groves and gardens surround smaller elongated sebkh and are connected by hatiets so that an almost uninterrupted green belt is created which terminates only in a longish, light acacia grove west of Ubari in the Irauen wadi. The entire wadi is rich in water and still shows traces of ancient settlement. Numerous gravefields are located on the scree foot below the steep, southern slopes where derelict foggaras, former aqueducts, running parallel to the short wadis descending from the table lands and so on to the oases, cross them as well. The most important oasis was Jerma, the chief place of the Garamantes and later a stronghold of the Romans. This role has been assumed by Ubari, 30 km. distant.

Separated by a 35 km. wide area of dunes there is a second string of 7 oases, rich in water, in the east: *the Buanis* (7 d_2) from Sebha to Um el Abid. In the east it is limited by the partially destroyed slope of the Serir el Gattusa. Today Sebha has replaced Murzuk as capital of the Fezzan. Amongst three older settlements, a modern administrative centre with a large mosque, a royal villa and its own power station has sprung up; it can be reached either by a 950 km.-long asphalt road which was completed in 1962, or by air from Tripolis.

8. The Sandstone Plateau of the Serir el Gattusa — Um Alla

Between the Ramlet and the western slope of the Haruj basement (Dor el Gani and Dor el Msid) stretches the *Serir el Gattusa* (Nubian sandstone) (8 a). The sandstones decline in a shallow, dissected scarp (30—50 m.) southward to the Hofra; towards the west and north the edge is more ragged and only in places does it rise above the Serir as a low, black hill country. The Serir area (500 m.) is slightly undulating, yellow to yellowish brown, becoming darker where the sandstone bedrock comes closer to the surface and lighter in the north and on the eastern margin where limestone occurs. The *Serir Um Allah Plateau* (8 b) which slopes more strongly towards the south, is more intensely dissected by broad wadi valleys, the margins of which frequently show strips of dust soil. It terminates at the Bab el Maknusa, a gap in the limestone table. The broad Neshaua wadi contains the small oasis of Goddua. At the Kneier wadi the Serir el Gattusa ends. North of the broad wadi valley limestone strata dip steeply, the flat serir tables of which have been blown over by long dunes which migrate into the Kneir wadi itself and up to the Ramlet Zellaf. The *Sandy Serir Limestones Plateaus* (8 c) (upper Cretaceous) extend up to the Jebel Sauda and at the eastern foot of the Gargaf they are overlain by larger dune fields (Ramla el Kebira).

9. The Hilly Sandstone Country around Ghat

The four oases of Ghat which are well endowed with water, lie in a *Low Sandstone Hill Country* (9 a) of Cambro-Ordovician age (700 m.), superimposed on crystalline slates and gneisses (pre-Cambrian) of the western Tassili. These latter rise to a higher mountainous country with long, undulating mountain ranges (1,200 m.). The black hill country (the rocks are covered with crusts) is traversed by broad wadis with vegetation and tmeds, parts of which are taken over by the Tanezzuft wadi which comes to an end in the Edeyin in the north; another disappears in the Erg Titagsin, i. e. the northern hill country. The wadis are the pastures of the Tuareg of Ghat.

Beyond the Tanezzuft wadi the steep slope of *the Akakus and the Tadrart Plateau* (9 b) rises in the east from steep detritus fans. The Akakus sandstone rises almost vertically through 100—120 m. to those pyramids, dome shaped knolls and towers which form the summits (around 900 m.) between which small hanging valleys open out. Towards the south the slope becomes more integrated and higher with the Tadrart sandstones of the lower-Devonian superimposed on it. Standing in front is the inselberg of the Idinen, the haunted castle of the Tuareg (Fig. 9), attaining a height of 1,280 m. and sloping steeply down on all sides. The highest points of the Tadrart (1,428 m.) lie above the small Elbarcat oasis (830 m. above sea level). The gentle eastern slope of the dark, stony plateau is dissected by short wadis ending on the edge of the Taita dune desert (Carboniferous). In the north the sand desert extends as far as the area of the small Serdeles oasis. In the east it changes (700 m.) into the detritus foot of the *Mesak Mellet Plateau's* (9 c_1) steep scarp (1,100 m.) which falls towards the Edeyin Depression of Murzuk. Steep block-filled valleys lead to the stony plateau (Nubian sandstone). In the almost equally high Amsach Settafed the plateau bends round to the east. It is traversed by wadis which begin to dissect only a few hundred metres before the serrated northern escarpment. As *Hamadet Murzuk* (9 c_2) (Escarpment: Ubari 425 m., plateau edge ca. 720 m.) the plateau changes over to the Serir Um Alla at the Bab el Maknusa Gap. It ends with a shallow scarp above the Wadi Berjush in the south which receives its dry valleys where dwarf shrubs and acacias grow and rock drawing can be found.

10. The Depression of the Edeyin of Murzuk Dune Deserts

From all sides the strata of the surrounding rim dip towards the Murzuk Depression which is for the greater part filled by a dune desert. The sands rise from the edge in the shape of a watch glass. In the entire northern area between the Hamadet Murzuk and the Edeyin there is a low strip (400 m.) which is followed by the *Wadi Berjush* (10 a_1), a place frequently visited by the Tuareg nomads because of its hatiets and wells. It finishes with the Endjarren wadi (from the north west) and the Neshaua wadi (from the east) at the *Etba Flats* (10 a_1). There are extensive salt clay areas in its deepest parts. These are surrounded by soft grey sand areas piled up with low dunes and hummocks in parts with here and there shrubs and acacias. There are some smaller oases with prolific sweetwater wells in their vicinity, the largest of these being Tesaua. Towards the east the depression continues in the *Hofra el Garbia* (10 a_2) and then the *Hofra es Shargia* (10 a_3). The oases, periodically sizeable and well endowed with water, are divided from one another by extensive sebkh with salt clay clods as well as young limestones with marl and sand areas on which are found tamarisk hummocks. Murzuk is the main place in Hofra and until a short time ago of the whole Fezzan. Traghen, Um el Araneb and Zuila are also worth mentioning, their antiquity being supported by remnants from Roman times.

The last oasis in the east is Tmessa, the hatiets of its area being prolific in vegetation (Fig. 10).

South of Tesaua a sandy, slowly rising foreland, with low, long curved ranges of dunes which frequently cross each other, leads on *the Edeyin of Murzuk* (10 b_1). The dunes then grow higher, adopting a north east to south west direction and soon reach a height of 100—150 m. Between the broad, substantial dune ranges which have presumably formed round a hard core of sandstone, there are broad depressions (Gassi) which in turn are divided into basins by lower transverse dunes. Thus a grand grid-pattern desert has been created in the northern and central part of the Edeyin. Frequently a sparse strip of scrub may be found growing along the foot of the higher dunes and it may even be possible to dig for water since the Tuareg speak of going into the Edeyin with their herds and remaining there for long periods. Only in the southern parts of the desert are the dunes supposed to lose height and to be orientated in an east-west direction. The bigger wadi el Kebir el Garegh extends from the southern border into the sandy sea (Fig. 11).

Towards the north east the desert sends out another tongue, the *Ramla Murzuquia* (10 b_2), its base consisting of coarse, stable sandy areas overlain by long, south west-orientated dunes of fine sand. They also confine the northern rim with the result that any crossing poses not a few difficulties. East of Tmessa the sands give way to coarse *Sandstone Serir* (10 c), often with blown sand, following the foot of the sandstone plateau of Madjedaul and the Jebel Ben Ghnema towards the south. Along the northern foot of the plateau it contains the *Madjedaul String of Oases* (10 d), snuggled into the broad outlets of the small wadis and having only small gardens and palm groves together with sebkh with larger hatiet in the vicinity. Along the western edge of the serir which is followed by the Hekma wadi there is the *Gatrun Row of Oases* (10 e) which starts in the north with the lumpy Bir Um el Adam and changing by way of several hatiets to the palm groves of the Gatrun oasis. The village is but small and there are already numerous seriben of the Tibbu. Those oases further to the south are separated from one another by sebka and sand strips with high tamarisk hummocks and wild palm thickets. Strips of scrub and isolated palm trees indicate the course of the wadi from the Tegerhi, the southernmost oasis, which is surrounded by extensive hatiets.

In the south the Edeyin are delimited by the rolling *Nubian Sandstone Plateau of the Mangeni* (10 f). Some black sandstone peaks and low mountain ranges stand above the plateau in the south west as in the case of the Jebel Ati (Carboniferous) and the Tummo mountains which contain sweet water in some grottoes at the foot of the steep wall of the Jebel War.

11. Jebel Ben Ghnema — Jebel Gussa

In the *Jebel Ben Ghnema* (11 a), Nubian sandstones and quartzites dip north west towards the Edeyin Murzuk Depression. The black plateau falls very irregularly in a steep scarp towards this side and rises towards the south east. A few sandstone remnants sit on top of the plateau (700 m.) which is at times rather constricted and already dissected at its southern end. The decline towards the south east occurs in two scarps, the narrow denudation terraces of which can be traced for a long distance despite their interruption by transverse faults. Scarcely any vegetation is contained in the short wadis. In front of the lower denudation terrace a sandy serir stretches together with the Bu Heira salt pan; east of it lies the low Mehershema hill country continuing towards the north as the *Jebel Gussa* and the *Dor el Gussa* (11 b) (Devonian-Cambrian). The sedimentary rocks show slight folding and faulting in their structure. Numerous sandy wadis, at times containing single acacias and dwarf scrub, dissect the Palaeozoic hill country and end on the edge of the Serir Tibesti or in the actual hill country in larger depressions (grarets) with rich vegetation.

12. The Extrusive Basalt Area of the Haruj es Sauda

The basalts of the extensive *Extrusive Area of the Haruj es Sauda* (12 a) lie over a base of Eocene and Miocene limestone and marls and cover an area of 40,000 square km. The highest parts are to be found in the Haleigh, the hilly plateau of which (800 m.) consists of numerous lava streams which have flowed over one another above which a number of volcanoes (Garet es Sebaa) attaining heights of 1,200 m., stand. The volcanoes appear to be arranged in rows with a north west to south east direction. Amongst them there are some giant craters with diameters of 3—4 km., shield volcanoes (Fig. 12), scoriaceous and tuff volcanoes, volcanic stumps and shallow explosion craters now filled with weathering material. Lava streams run in all directions. One of the youngest of these is probably the black, glossy Msheggheg stream which flows towards el Fogha. Between them lie smaller and larger sandy basins, the yellow alluvial deposits contrasting sharply with the black and grey basalts. Frequently light acacia groves exist in the larger basins and, following the rains, grass and bushes may also shoot up. The basins are frequently connected with one another with the effect that radiating from the Haleigh quite a number of larger and smaller wadis developed. These sometimes flow until they gain the foreland or come to a halt between the lava streams. In the main the western edge of the Haruj breaks off sharply towards the surrounding limestone serir. From the eastern edge flow a number of lava streams, enclosing bays of sandstone and serir areas, which in turn shroud the lava streams with sand and dust. In the Angud el Jaserat (southern part) two rows of volcanoes extend towards the south east foreland and each contains some twenty volcanoes (Fig. 13). In their prolongation there are still a few more single volcanoes which are again flanked by larger basalt areas from the Haruj. Shorter rows of volcanoes are situated in southern direction to the Haruj. Its southern-eastern corner pillar is formed by the great caldera of the Wau en Namus (diameter 4.5 km.) with a central crater and three lakes. Date palms, acacias, tamarisks and reeds grow in this lovely "black oasis", in the wider vicinity of which not a single living plant can be found.

Semi-nomads who like to visit the western Haruj after the rains with their herds are sure of finding adequate pasture there. The animals come from Zella, Fugha, the eastern oases of the Fezzan and the Wau el Kebir (Tibbu). Those basins which are closer to the oases are also used for rain-agriculture.

The *Limestone Serir of the Western Basement* (12 b), the Dor el Gani and the Dor el Msid, descends in steep scarps to the Serir el Gattusa. There are some hatiets and wells in shallow marginal depressions between the Haruj

and the Serir. Only a few wadis pass westward; they cut deeply into the limestone. In the Serir area as well some basins have been incised and are in parts twisted (dolines) and in the northernmost corner of which lies the small oasis of Fogha. There is a sebka with some vegetation at its centre, the village, palm trees, gardens and wells being situated on the eastern edge. In the northern part of the Serir basement the broad valley of the Agheib Wadi attracts all those wadis which descend from the Haruj and the Jebel Sauda; its southern part is markedly constricted by the Dor el Gussa.

The north eastern and *Eastern Basement* (12 c) is dissected by a number of wadis with some vegetation which generally terminate in grarets. In the basement *south of the Dor Abregh* (12 d) gypsum and marl strata with fine sandstones have been deposited; isolated basalt caps persist while between them the softer rock has been worn away to become extensive gypsum and marl dusts areas together with gypsum pans. Low rows of volcanoes and basalt caps march in isolation from the north west to the south east across the southern basement in front of the Haruj. Small limestone plateaus and sand areas lead on to the Rebiana Sand Sea and the Serir Tibesti.

13. The Serir Tibesti

The Serir Tibesti with its wide, yellowish-white coloured, slightly *Undulating Serir Plain* (13 a) extends over Eocene limestone to the starting point of the coarser scree foot of the Tibesti Mountains and ends in the east at the basalt tables which have flowed from the Palaeozoic Dohone Foreland (crystallines, slate, gneiss) as far as the Eocene measures deposited in front. Roughly in the middle of the Serir the Hedshar Jebel limestone plateaus, some 40 m. high, stick out surrounded by gypsum crusts and a belt of marl dust.

The *Western Edge of the Serir* (13 b) also contains some lower limestone plateaus and isolated mountains, the southern part of which is, however, of slates and intrusives which form low hill ranges. In the northwestern corner the Wau el Kebir is entrenched. This is a broad basin with steep rims, the village being situated on its northern side. Dunes fill the centre of the depression which is surrounded by small palm groves, plants and grasses. The Tibbu graze their herds in the wider environs, in the Jebel Gussa and as far afield as the Haruj es Sauda.

c) Cyrenaica

14. The Eastern Sirteland

A short way beyond the Tripolitanian border at the first large coastal sebka near Agheila the eastern Sirteland begins. The rocks of the middle Miocene, particularly limestone and marl, continue towards the east but are no longer broken up by faults as has been noted further to the west. The transition from desert to steppe commences soon after the 30—40 km. wide coastal strip inland from the sea.

The first large sebka in the *Oases-Coastland with Sebkh, Dunes and Low Bushes* (14 a) is the Mugtaa el Chebrit which flows into the Wadi el Faregh from the east. Towards the coast it is partly divided off by fine-grained brown and white limestone sand-dunes. Its sterile sand clay areas are surrounded by salt plants and sand strips. The small township of Agheila is situated about 10 m. above the sand beach on a hardened, cemented dune range providing a view south over bush flats which rise gradually in the south before falling away a few metres at the Maaten Joafer well towards a broad sebka which is a part of the lower course of the Wadi Faregh. Between coast and wadi behind the dunes there are further extensive sebkh with lagoons and salt plants. Small palm groves grow on the somewhat higher dune strips and often a little white house can be seen adjacent to them. In front of a hardened strip of coastal dunes the Esso oil-port of el Brega is situated with its refineries, township and a little harbour protected by a pier. The oil is conveyed to the ships in the roadsteads. The large Sebka el Mrer is the last one towards the east. Beginning there is a broad dune strip with thinly scattered Mediterranean bush, salt plant depressions and only isolated small sebkh continuing beyond Zuetina where, near a palm grove, some wine is even produced.

The *Desert Limestone Plateau of the Sirte with Sebkh* (14 b_1) which follows towards the south east, is limited by a shallow swell in the east. The shallow sebka just in front of it is an extensive, light-coloured, shallow limestone plateau, strewn with stones with single low limestone and gypsum tables, often much dissolved, sitting upon it. Towards the northern edge it is embayed at times by depressions. In these bays large sebkh with salt plants and dunes are situated, examples being the Gheizel sebka or that of el Gheneien (512 square km.); the latter receives the Hamia wadi which, coming from the east, is covered with a good dwarf-scrub vegetation. The sebka itself is covered by wide stretches of sand; only here and there salt clay soil comes to the surface; salt plants grow on the margins. Many rows of small and mostly sterile sebkh lie in depressions scattered over the limestone plateau.

To the north the limestone plateau changes to a somewhat lower hill country — the Barga el Beda — covered by bushes, shrubs and herbs which gradually become more sparse towards the south. After rains in spring the country brings forth a short-lived pasture of spring flowers. The southern Barga is traversed by the broad valley of the Faregh wadi which begins on the eastern rise. Its middle course is about 300 m. wide and increases to about 5 km. in its lower reaches. At the centre of the Barga and thus of the nomads' area is the small town of Ajedabya. It is surrounded by eucalyptus plantations which are intended to stablize the dunes, and by the nomads' fields in shallow small valleys and troughs of the low bush-steppe.

In the south the limestone plateau ends at the *Marada Depression* (14 b_2), falling down to it through about 80 m. in a steep scarp which first increases to 140 m. in places and then decreases and can be followed almost as far Jalo. It may have originated in tectonic fault lines which can be traced as far as Jahgbub. They may have formed a shallow trough initially which was subsequently widened and deepened as water and salts acted as solvents on the limestones, marl and gypsum. The largest basin is the Marada (about 10 : 40 km.). On its northern rim there are extensive sebkh; their floors consist chiefly of broken salt clay clods forced against each other. The most important salts which occur consist of carnallites. In the south swarms of remnant mountains indicate the rim of the basin where oil was found. Here the salt clays are

covered by hummocks and bushes. The houses of the Marada settlement (10 m.) are situated at the foot of a low hill not far from the oasis with small palm groves and gardens. Also the eastern valley-like continuation still contains individual sebkh and a twisted dwarf-bush strip ending in the long sebka of Meheiriga.

A shallow plain in the surrounding coarse serir leads on to the *Oases Depressions of Jalo* (14 b_3). The three oases of Aujila, Jalo (el Ergh) and Jikerra lie in flat basins with gentle slopes which are sunk into the serir. They are filled with sand and followed by low dune ranges. Jalo (el Ergh) is the main settlement. In sparsely distributed palm groves the inhabitants have established gardens which are irrigated by brackish well water. Goats and sheep find food in hatiets (sparsely vegetated strips, chiefly in depressions) in the vicinity which are also to be found in the remote north eastern area together with some wells. The most southerly of the wells — the Bettafel Well — located in a bush depression in the south east which is to date the last before one reaches the Kufra Oases, provides good drinkable water with only 0.5 g·Cl/l in contrast to the rather brackish water of the oases (1.5—3.5 g·Cl/l and over).

Between the southern slopes of the Jebel Akhdar and the Erg Jarabub in the south extends the slightly vaulted *Limestone Desert Sirte Swell* (14 c_1). A number of wadis begin their courses upon it and run off to the west and east. The largest of these are the Faregh wadi (see above) and the El Mra wadi which follows a course south eastward. In the north the swell commences south of the Balte zone (vide 15 c) and here in depressions and the remnants of wadis are to be found small pastures of dwarf shrub and even cisterns for the animals. The eastern edge of the swell is marked by a slightly ragged scarp. In general this desert swell is little known: in the south dune fields migrate across the stony limestone surface and it terminates at the extension of the *Marada-Jalo-Jaghbub Depressions* (14 c_2) across which the caravan route runs. It is marked by some hatiets in shallow basins. South of the depression the dunes of the Jarabub Sand Desert begin.

The Barga el Beda (see above) directs another branch of the Sirte Tableland towards the north: this is the *Barga el Hamra* (14 d_{1-3}) consisting of Miocene limestones. It narrows gradually between the coast and the Jebel Akhdar.

The Coastal Oasis Strip of the Barga el Hamra (14 d_1) remains initially like that near Zuetina with sand dunes dominating; then palm groves and small sebkh occur between the dunes, the latter being linked with the sea at Benghazi. Salt is won from them. Between the northern and nowadays mostly dry and southern permanently water-bearing Selmani sebka, situated on a hill lay Euhesperide — later Berenice — the oldest Greek settlement. Following the destruction of the Greek town the ancient Arab *town of Benghazi* (14 d_2) was set up on a low hill with a cliff between the sebka and the sea. The lagoon which was connected with the sea by way of the sebka di Punta, was used as a port. Finally the bay between the Gesiret Geliana and a smaller northern precipice was safeguarded by strong piers linking the offshore reefs. In addition to this dock a second deeper one was recently completed in the north. A European town was attached to the Arab one, developing between the port and lagoon towards the south. At the present time it extends over the former el Berka village towards the south and east. North of the town and on the coast begins the oasis in a sand and dune terrain; vegetables are cultivated in gardens there and small slum settlements built from corrugated iron, boxes and torn tents have sprung up. They are to be removed and fifteen hundred dwellings are being constructed along the Benina Road which leads to the large airport handling traffic to the east.

Towards the north further sebkh are found behind the dunes; an example is the Ain Zeiana which is connected with the sea and there are also small palm groves such as that at the Coefia settlement and the small village of Tocra itself an ancient settlement (Teuchira) with a fortification and remains of its walls.

In the south the rolling *Limestone Plateau* with a width of about 50 km. and *Covered by Dwarf Scrub* (14 d_3) commences; this is at first more a sparse low bush and herb steppe between bare limestone areas and the hard brown soils of shallow depressions but gradually the carpet of bush and dwarf scrub becomes denser and the number of fields increases. Between Ghemines and Soluk the fields themselves also grow larger and are supplemented by small plantations of trees and eucalyptus groves particularly in the Benghazi Heights. Towards Tokra and the mountains bare limestone crusts again frequently form the surface and only short wadi remnants and dolines are better cultivated. There are numerous subsided dolines in the vicinity of Benghazi, the larger of which are often filled with water and fringed with reeds and rush thickets and the dry ones planted with gardens and trees; figs, citrus fruits, almonds and some palms are grown just as in the case of the blind "Lete" wadi which terminates in a cave with a dark lake. They are said to be the former gardens of the Hesperides. Apparently dolines, wadi remnants and subterranean karst water-courses are connected just as in the case of the frequently interrupted Gattara wadi which ends south of Benghazi in numerous small sebkh.

15. The Mediterranean Scrub Hills of the Jebel Akhdar

The elliptical Jebel Akhdar, the Green Mountains, were apparently slightly upwarped before the Eocene. Their axis runs east-north-east and with it long faults which are intermittently transversely fractured. The seaward-sloping side falls away more steeply and mainly presents fractures and flexures. The rise from the sea occurs in two main steps, the lower of which reaches up to 300 m., the upper to 500—600 m. The latter passes into the plateau which culminates in a crowning hill country attaining a height of 882 m. The anticlines are overlain by shallow deposits of the Oligocene and Miocene consisting chiefly of limestones, calcareous sandstones and marl. Where the Eocene outrops it lies discordantly on the upper Cretaceous. Both are exposed in certain breaks of the strata in shallow anticlines.

The Northern Scarp Slope (15 a) carries a thick-leaved low bush cover, often sparsely grown and remnants of scrub forest on the denudation terraces. The scrub consists of pine, cypress, holm oak, acacia, carobs and juniper bushes; it is interrupted by cultivated stretches. The slope is dissected by wadi valleys which originate partly in the scarp and partly from the plateau. The first scarp slope runs out in a talus foot in front of which lies a predominantly *Hilly Coastal Strip* (15 a_1) with scattered bay-like sand and gravel beaches which

forms an extension of the Barga coastal strip. On the gently hilly territory there still exist from Greek times calcareous limestone quarries as well as grave towers and individual graves. The present village huddles against a low hill which fall steeply down to the sea and offshore cliffs, forming a small bay with them. On the sparsely vegetated hill country behind stretch the ruins of Ptolemais with the lower scarp slope rising steeply above them. Towards the east the scarp slope with its talus slope advances hard to the seashore until near the little port of Apollonia (Marsa Susa) the coastal strip broadens into low hill country, the limestones of which, covered by red soil, support dry fields and scrub which continue across the less steep slopes up to the first scarp. At the Heights of Ras Hilal the slightly broadening hill country breaks off with a shallow scarp eastward towards the sea. Thus from this point onwards the detritus of the first steep scarp forms a low-cliff coast (5—6 m.) dissected by short wadis. At the exit of some longer wadi valleys there are a few smaller settlements (Latrun, Kersa and others) on the thickly overgrown scarp slope but these apart, only sparse scrub grows on the talus and macquis with beach pines in the wadi gorges.

Before the Derna wadi leaves its deep canyon-like valley there is the little oasis and coastal town of Derna set in the hilly country and surrounded by gardens and plantations of palm trees, oil trees, figs and bananas. The scarps and plateaus which support scrub in places, fall away from here eastward towards the Gulf of Bomba.

The *Scarp Slopes and Plateau* (15 a_2) of the Jebel Akhdar already start in the west over the Barga el Hamra. The first scarp slope at Sheleidima (east of Soluk) is 80—100 m. high. The first terrace is of hill country covered by scrub which rises towards El Abiar in the north and turns towards the east at Barce. It is characterized by advanced processes which are creating a karst topography. Wadis alternate with flat basins, troughs and dolines infilled with red soil and cultivated and divided by limestone ridges which present karst features and hill ranges covered by sparse scrub. The wadis come from the second scarp slope and they are here deeply entrenched whereas on the first scarp they often end up in blind valleys. Somewhat to the north near Fasura (Baracca) was situated an Italian settlement area which, like all the others in Cyrenaica, has been taken over by the Arabs. The semi-nomads who had been settled there neglected fields and houses at first, the latter being used as cattle pens with their black tents pitched next to them. Only gradually did they begin to plough a few of the fields which had become scrub covered in the interim period.

The troughs probably owe their origin to karst erosion. The largest of them is the Barce polje (el Merj). The village is situated on the northern edge and is surrounded by tree plantations. In 1963 it was largely destroyed by an earthquake. During winter a lake forms in the polje; it can so grow in size that the houses around it stand in water, whereas in summer grain is cultivated in the floor of the lake. The reddish-brown soil which is about 10 m. deep retains its humidity for a long time. Thanks to the fertility of the polje an agricultural research station has been located there. Smaller settlement areas extend from here eastward by way of Maddalena as far as Oberdan. With the aid of artificial water supplies from the east the entire district is scheduled to be transformed into an irrigation area.

Apart from the smaller cultivated parts the main scarp, which narrows slightly towards the east, is covered by dense Mediterranean scrub or scrub forest. It consists in the main of evergreens: citruses, pistazias, carobs, junipers, pines, acacias, holm oak and others. The scarp is dissected by some larger wadis which descend from the plateau which, as in the case of the canyon of the water-bearing el Caf wadi particularly, still contain some poor remnants of former pine and cypress woods which climb up to the plateau as individual trees. Only below Cyrene are there more extensive fields again and these are themselves soon ousted once more by scrub which also covers the slopes of the deeply-etched wadis. As in the cases of the Latrun and Derna some wadis contain flowing well water. At its mouth small lagoons have formed behind gravel banks which contain the larvae of mosquitoes (anopheles). East of the road to Tobruk the first main scarp slopes down towards the sea.

The second main scarp, over 500 m. high, widens to the *Plateau of the Jebel* (15 a_3); a low karst hill country (Slonta) rises in the south. In the western part around Gerdes el Abid numerous short wadis dissect the scarp (see above); sparse, evergreen scrub covers the land and nomads erect their tents there. In some places larger, enclosed areas have been afforested and form a dense scrub forest. Dwarf shrub steppes with isolated bushes extend towards the heights. There are numerous cisterns, both for people and stock, a great number of which date back to ancient times. They are situated mainly in the more densely settled area of the plateau, where Beida is now raised to an administrative center. Westward of this the viticulture area of Messa extends.

Wells are sparsely distributed. In shallow basins, dolines, and dry beds the nomads cultivate fields and on occasion even kraal-like fences for the herds may be seen. Towards the east the country gradually falls away. Broad wadis, or more correctly karst basins aligned side by side, run northwards and then bend in that direction. At times as in the cases of occurrences near Gubba, Mara and in the upper course of the Derna wadi, they contain springs, the water from which is soon taken up for irrigation purposes. There are nomad settlements with fields in some of the wadis like the Um er Rezzem which flow eastwards to the sea. Individual giant springs in the wadi valleys — like the Debussia Spring and the Ain el Bilad — provide water by way of pipelines for the plateau areas and places as far afield as Barce and Tobruk.

Not far south from the watershed which follows approximately the highest parts of the mountain range begins the *Southern Slope of Low-bush Steppe* (15 b). Shallow indentations and small basins in the karst lead on to valleys which cut down rapidly. During the winter months they receive still ample rain. The valleys are separated by elongated interfluves, the vegetation of which soon changes from higher scrub to poorer and poorer dwarf-shrub steppe. The more prolific vegetation first recedes to the valley slopes and then entirely to the valley bottoms. These widen towards the gently undulating hill country which replaces the scarped landscape of the interfluve slopes. Some isolated and small nomad settlements are located here, as for example Ezzelet, Mechili etc., with cattle pens at the wells, a few enclosed fields and some trees (figs, acacia).

The wadis terminate at the edge of the low, flat, stony and sparsely bush-covered knolls and form brown

alluvial plains with salt efflorescence and salicornias in places. In winter the areas are often flooded. They are *the so-called "Baltes"* (15 c) which occur in a belt which marches with the southern edge of the Jebel. It would appear that they cannot be considered in connection with tectonic movements or karst phenomena. In this belt the barren stone desert with sand dunes and naked clay areas asserts itself increasingly.

16. The Dwarf-shrub Desert of the Marmarica

South of Tmimi on the Gulf of Bomba at a height of about 150 m. the Marmarica Plateau begins at the Jebel Akhdar. It falls in three steps towards the coast, the lowest of which meets the sea as a cliff east of Tobruk. The plateau is made up of limestones, calcareous sandstones and marls. It finishes in the south above the Jarabub Basin. The last of the outliers of the hill country approach to within 8 km. of the coast at Tmini. Several small wadis arriving here from the hills have deposited the *Low-scrub Coastland* (16 a_1) which widens once more to 15 km. further east until a pipe-like inlet extends as far as Ain Gazzala and thus almost as far as the lowest scarp of Marmarica. Several sweet water wells make this area attractive to the nomads. The coastal road which is followed by the silver ribbon of the water conduit from the Derna wadi to Tobruk winds its way across a protruding, low range of hills which follows the coastline to Tobruk. The town is situated on the projecting peninsula formed by the last offshoots of the hill range. The peninsula embraces Libya's best port with the Marmarica scarp but unfortunately there is no hinterland to it. Recent plans provide for the expansion of the town, since a pipeline is being built from the rich C-68 oilfield of the British Petroleum Company, 150 km. south east of Jado to el Hariga 4 km. east of Tobruk. The lowest Marmarica step on which the German cenotaph of the second world war is located, merges at times with the second one in the east. Both the steep faces thus form the cliffs of the abrupt coast which turns south before Bardia. Short fjords penetrate the scarp here. The small settlement is situated between two fjords about 60 m. above the sea, the protected harbour being in the southern fjord. Receding to the south the cliff coast ends at Sollum.

On the lowest hilly denudation terrace (60 m.) there are still some settlements with few houses and fields dependent on cisterns; the second scarp slope leads up to an area (140 m.) south of Tobruk which was chosen by the English for the construction of the el Adem airport with a large barrack; the third slope only a few kilometres further behind, leads up to the *Dwarf-shrub Tableland* (16 a_2) itself. The scarp slopes of white limestone are strewn with stones eroded by stream wash and a few wadis and show only a sparse vegetation. On the tableland which lowers itself gradually towards the south and south west, the steppe is interrupted by extensive, barren limestone areas. Numerous cisterns and isolated wells which still show the remnants of fortifications from the last war, serve the nomads and their herds. Towards the south the limestone table is traversed by a few broad wadis with occasional dwarf bushes, widening during their course to larger depressions in which the mud of the last flood cracks up into polygons. In most cases they terminate in barren brown pans or lose their way in stony hamada areas.

Thereupon the *Desert Table* (16 b_1) has been reached (100 km. north of Jaghbub). A ragged scarp which can be traced for about 10 km. to the east, limits the broad valley of the el Mra wadi, which is apparently approaching the Jaghbub Depression, in the north. South of it individual broad table areas rise out of the hamada to be followed soon by the falling away of the table towards the Jaghbub Depression. Today a tarred road runs from Tobruk to Jaghbub, following the broad wartime barbed-wire fence, which in turn follows the eastern border from Musaid (Capuzzo) on the coast, over its last stretch.

The width of the *Jaghbub Basin* (16 b_2) attains 20 km., its length 50 km. The abrupt scarp (120 m.), limiting it to the north, displays irregular incisions and indentations and rises through several steps towards the Marmarica Table whereas the southern slope only attains heights of up to 72 m. In places the bottom of the basin sinks below sea level (down to —29 m.); at the palm grove below Jaghbub which is situated on a low gara (hill), it sinks to —17 m. The place is over-topped by the gleamingly white Gubba, beneath which is located the sarcophagus of the founder of the Senussi Order. The lowest parts of the basin are filled with extensive sebkh, covered with brown dust and sand, some of which have broken up into blocks. In some of them are situated salt swamps and wells (Melfa, Gsebaia). Small islands of scrub, at times with palm trees, grow on the edge of the sebkh. Towards the east depressions with sebkh lead on to the Siwa Depression and towards the west to the Hattia of Hifan and the Bu Salama well. Extending further westward there are still more hatiets which serve as camel pastures for caravans.

17. The Dune Desert of the Jaghbub Erg

On a flat limestone table south of the Jaghbub-Jalo Depression the *Erg Jaghbub Dunes* (17 a) begin; at first they criss-cross one another in the north like a lattice-work dune desert and then they swing on to the south westerly direction. In the south the dunes surge against the Kufra hill country (19) in front of which there are some outliers (at Bir Dacar) and the small hattie of el Mehemesa. From it the *Jaghbub Serir* (17 b) protrudes towards the north like a finger, partly decked in sand and containing low dunes. Isolated low limestone hills thrust from it. The serir divides the erg from the *Great Libyan Sand Sea* in the east (17 c).

18. The Calansho Serir

The Calansho Serir is a vast, almost flat plain with a north-south extent of about 400 km. and an east-west length of about 500 km. From the south it falls through about 250 m. to a height of 80—100 m. on its northern edge at Jalo. Only along the margins at particular places does the bedrock emerge as a calcareous sandstone (Oligocene and Miocene). In the north east gravels and a gravelly boulder pavement cover the slightly *undulating serir surface* (18 a_1) which is dissected by the long, extended, sandy depressions of the *Faregh wadi south of Jalo* (18 a_2). Water has recently been drilled for in this part. *South of the wadi the serir* becomes more sandy; larger dune fields migrate towards the south west (18 b); the extensive Tazerbo group of oases and the uninhabited Zighen group — which afford not only salt water but also sweet — lie on the southern margin. West of the centre the 100 km. wide *Calansho Erg* (18 c) runs across the serir. The Calansho Erg consists of long, south west-

oriented ranges of dunes about 50 to 80 m. high; dune fields which break off from it in the south even cover the edge of the Haruj el Aswad. In the north dunefields surround the 140 km. long *Zelten Table Mountain* (Oligocene and Miocene (18 d) with a relative height of about 300 m. The plateau area which is covered with coarser stones, slopes gently towards the north east. Buttes rise from its steep flanks, especially in the north and north east. Oil deposits have been located in its vicinity and are being exploited. Towards the *west* the *sandy serir* (18 e) grows whiteish in front of the Haruj basement. It also shrouds the shallow Maabus el Gerad hillrange. Several wadis originating in the Haruj terminate in shallow pans in the serir in front of the erg.

19. The Kufra Hill Country

The Kufra hill country consists in the main of an extensive *Sandstone Plateau* (19 a) which is undergoing the process of destruction and exposes black quartzite capping, 1 to 2 m. thick, on its surface (Palaeozoic and Nubian sandstones). Mountain-building movements caused the sandstones to be arranged in shallow undulations and frequently broke up the quartzite into blocks. Rough and coarse quartzite blocks rolled over the slopes which have been formed into terraces by thinner quartzite strata between the sandstones. Once the quartzite layer has been destroyed the degrading of the plateaus and mountains proceeds swiftly. In the east the plateaux have already been reduced to short parallel ranges and isolated mountains with gravel-filled troughs between them. Their last spurs approach the sandstone plateau of the Gilf Kebir. The hill country is quite without vegetation.

At the foot of the southern plateaus the extensive palm groves of the *Kufra Oasis* (Kebabo) (19 b) extend in a shallow trough. The principal oasis of el Jauf contains two small saltwater lakes in its twisted river-like sebkh. The wells provide good water from a sandstone sub-stratum (6—7 m. deep). In the vicinity of el Jauf there are further small oases and hatiets with low bushes. Thirty metres above the main settlement, et Tag with its Sauia — a sanctuary of the Senussi — is situated on a sandstone plateau. In the east and west the depression with its oases is delimited by low remnant hills and in the south by table mountains of the Sarra Plateau.

20. The Rebiana Erg

The Rebiana Erg extends south of the Calansho Serir. Its dunes, the highest of which lie south west of Tazerbo, wander towards the south-west and have penetrated the Tibesti Serir like a long tongue. They advance towards the sandstone plateau of Egei and have covered several low table mountains, especially towards the Sarra Plateau, with sand areas and long ranges of dunes. Single mountains and the higher parts of the sandstone plateaus rise over the sand sea. From the north the dunes and sand from the Serir, from the Calansho Erg and the Jaghbub Erg penetrate the Rebiana Erg. On the eastern edge of the Erg the Rebiana Oasis lies at the foot of short sandstone table mountains and north of it the small Bzema Oasis with a palm grove on the shore of a small salt lake is found.

21. The Jebel Egei

The Jebel Egei is a *sandstone plateau of the Nubian Serie* (21 a), rising to about 1,000 m. above sea level and breaking off in steep slopes on all sides. The plateau, which tilts towards the north, is surmounted by some higher mountains, apparently volcanoes, with lava streams poured out through the valleys towards the southern foreland. West of the Egei Wadi a somewhat lower and extensive *Basalt Extrusion Area* (21 b) stretches as far as the gap which allows the piste from the Wau el Kebir to the east to run through. It lies on Palaeozoic rock. South east of the plateau a low spur branches off, falling sharply to the south east, ending in the Jebel Clinge and continuing in the plateau remnants of the Tneneca. Low tabular blocks, tilted towards the south east, lie in the *eastern foreland* (21 c). Some wadis are reported as carrying vegetation, albeit only after rains then they are visited by Tibbu nomads.

22. The Dohone

The western part of the Dohone (Dohozano) (22 a) consisted of sand-filled, rocky hill groups of Precambrian age and low granite ranges across which larger basalt tables, particularly in the north, have flowed. These lead streams to fan out as far as the Tibesti Serir (Eocene) and the low hill country is also over flowed. A number of deeply fretted wadis stem from the Cambrian scarp in the east; some of these end up in the 100 km. long Tussidi salt pan, others lose themselves in the Tibesti Serir (q.v.). Here and there tamarisks and acacias grow in the wadis and low bushes and herbs become green only after rains. Villages are in consequence mostly deserted, particularly as even the few wells and galtets (open waterholes) dry up easily.

The Cambrian-Ordovician scarp rises about 150 m. to an extensive *Sandstone Plateau* (22 b) about 900 m. high which falls to about 600 m. in the east. Superimposed sandstones (Ordovician and Gotlandian) on its eastern slope are frequently dissected in such a way as to form steep domes and tables. In the south the Kemet (Gubo Massif; c. 1,800 m.) together with the Pic Bette (2,286 m.) surmount the sandstone plateau which forms the link with the Tibesti Massif rising to over 3,000 m. by way of Uri in the south west. Towards the north the plateau falls to 1,200 m. and then to about 700—750 m., finally changing to the Jebel Egei Foreland (see above). The highland which is also overtopped by a few volcanoes (Grei Mado, 1,100 m. and others) is cut up by deeply rent and partly narrow valleys. Apart from tamarisks and acacias the wadis contain scrub vegetation in their lower courses. They disappear in a shallow furrow towards the scarp of the Sarra Plateau in the east. In 1958 the few periodic settlements were deserted since it had not rained for five years and the waterholes were empty. Only two or three families remained behind in Tuzugu village; there were a few more in the Taskemamal Wadi, in the upper course of which one well was still running.

23. The Sarra Plateau

The Sarra Plateau of Nubian sandstones, quartzites and conglomerates (lower Cretaceous?) is a large serir tableland with scattered extensive mesas above it. Migrating dune fields, in parts elongated, move across the serir towards the south west. The highest parts of the serir are in the west, the Logei Tomo (almost 1,000 m.) marking the point where the plateau approaches Tibesti. On the southern edge which fall in scarps to the foreland, the heights attain about 600 m.; on the northern edge

they reach about 500 m. and south of Kufra about 400 m. above sea level. The Assenu Wells on the edge of the Rebiana Erg on the Tibesti-Kufra piste (35 m. deep) as wells as Sarra (68 m.) and Bishara (25 m.) on the Kufra-Tekro caravan route running across the serir are worth noting. The serir lacks vegetation and is uninhabited. Pre-Cambrian crystalline slates and gneisses together with intrusive rocks interrupt the Nubian sandstones at the Jebel Auenat on the east of the plateau which reach the Gilf Kebir in the north, in the south the Sudan.

24. The Jebel Auenat-Arkenu

The crystalline slates and gneisses begin about 70 km. west of Arkenu, extend between 21° and 23° N. and are still found east of the southern tip of the Gilf Kebir sandstone plateau. The junction between Nubian sandstones and crystallines is very distinct in places. The sandstones begin above a low scarp, but are still overtopped by small crystalline mountain ranges (Fig. 14) in the surroundings just as is the uneven crystalline area itself (between 600 and 700 m.). Several inselberge have been created by the intrusion of granites and diorites and of these the Jebel Uweinat at 1,892 m. is the highest of them. Rocks of the granite series, gneisses and crystalline slates alternate irregularly and are at times superimposed by Cambrian (?) sandstones which form the summits of Uweinat and Arkenu (1,360 m.) as well. Both inselberge are traversed by broad and stony valleys which, apart from acacias, carry little vegetation. There are wells and waterholes which enable wild sheep (waddans) and the few inhabitants (Tibbu) to exist. The Italians channelled the water of the Ein Zueia through a short pipeline to a cistern on the edge of the mountain. Herds of camels, goats, sheep and donkeys (and, in 1958, one cattle) come here to drink. In 1958 the Jebel Arkenu was completely deserted. Tracks indicated that at times it had been inhabited. About once every seven years rains fall in association with heavy thunderstorms which cause the wider surroundings to be inundated. This is particularly the case with a depression 30 km. west of Uweinat which provides sufficient pasture even in dry years. After the rains herds from Kufra and Erdi arrive at the pasture in order to graze for about two years.

The surroundings of the inselberge, including the Jebel Kissu (1,712 m.) some 30 km. away in the south, are of a hilly, sandy nature. Long rows of dunes, several kilometres wide, stretch between the mountains; sand, gravel serir and areas of coarse rocks surround the feet of high and low mountain ranges alike as, for example, the Jebel Babein in the north east, from which bands of intrusions often fan out and can be traced far beyond into the plains. Some mountains are of younger volcanic origin. Some crater-like depressions, said to have been formed by meteorite impacts, have been discovered in the crystalline mountain ranges.

2. Geological Survey

The broad outline of Libya's geological structure has become well known, particularly through the efforts of Italian research and the drilling programmes carried out by the oil companies. Only a general survey will be attempted here and this can be followed up on the sketch-map (Map 4).

The oldest rocks, gneisses, crystalline slates and the series of granite intrusions, outcrop in the south of the country in the Jebel Arkenu-Auenat, in the Tibesti Mountains and in the Fezzan. Two stages, namely the Archaean and the Algonkian (Pre-Cambrian), may be distinguished, the latter showing Pre-Cambrian folding which would accord with Huronian orogenesis.

These are followed by a longer continental period between the Pre-Cambrian and the oldest Palaeozoic rocks, as must be deduced from the large break in the strata here. Then came the first period of uplift a effecting the mountains at the time of the Caledonian movements towards the close of the Silurian; the strata were included in the folding. The ensuing series of Devonian-Carboniferous strata, and particularly those in the western Fezzan, are of partly marine and partly terrestrial sediments, subjected to movements at the close of the Carboniferous (Varistian folding). The anticlinal axes of the Jebel Gargaf and the Dor el Gussa were upwarped; simultaneously intrusions of granitic rocks occurred as well as uplift of the Palaeozoic and the lower Nubian continental sandstones (Devonian-Carboniferous-Permian); these are indicated on the map as NP (Nubian sandstones of the Palaeozoic) in northern Tibesti, Auenat and the Kufra mountain country. The upper Nubian series (Permian, Triassic, Jurassic and lower Cretaceous) consist in the main of continental sediments (NM = Nubian sandstones of the Mesozoic). As in the case of the lower series, they were deposited in the wide basins between the upwarpings mentioned above.

During the Jurassic and Cretaceous sedimentation in N.W. Libya was influenced by slight fluctuations of the sea. In the Senon (upper Cretaceous) the sea once more gained a maximum extension to the south, but as western Libya was uplifted it became mainland with the exception of the northern coast. Development in eastern Libya took a different course. It was once more inundated by the sea with a large but shallow Gulf of Sirte extending to the fringe of the Tibesti; towards the end of the Eocene it passed the Tibesti in the west and was thus able to connect up with the seas in the south. Then it finally withdrew to the north.

During the early Tertiary the Tripolitanian Jebel as a fading ripple from the Tunisian Mountains and the Jebel Akhdar in Cyrenaica probably as branches of the so-called Syrian Bow, were uplifted as offshoots of the Alpine folding. The upwarping of the former occurred during the Eocene and the Oligocene, earlier than the Jebel Akhdar, Miocene strata of which are included in the folding. The northern flank of both mountains declines more steeply than the southern flank; both show fractures, flexures and faults running in a north-south and east-west direction. The Jebel Akhdar rises partly from its sea-covered coastal step through two further main steps at 300 and 600 m., finally gaining a maximum height of 880 m. The Tripolitanian Jebel starts at the wide coastal plain of Jefara which rises slightly towards the south to about 300 m., reaches a height of 600 m. in one steep scarp and then rises further to 960 m. before it finally sinks towards the south. The scarp forms a shallow curve along which older rocks (Triassic and Jurassic) come to the surface.

During the Miocene yet another slight subsidence occurred in eastern Libya, thus pushing the coastline forward to 29° N. Then the sea continuously withdrew. But until the most recent Quaternary slight movements brought their influence to bear upon the extensive lines of fractures and fissures which cross one another as they

follow a N.W. to N. and N.E. direction. Tectonic troughs, like the Hon Trough between Zella — Hon and Bu Ngem, follow these lines wherever magma rose until the Quaternary to form series of volcanoes and basalt outflows (Haruj, Jebel es Sauda and others). Occasional earth movements may still be observed at our present time. Tertiary movements probably also still effected the southern mountains and intrusions may have caused localized uplifts.

Apart from the old, metamorphosed rocks (crystalline slates, gneisses and others together with intrusives such as granites, diorites etc.) in the southern mountains of the country, the structuring sedimentary rocks in the south are predominantly represented by Palaeozoic and Nubian sandstones and marls and more recent eruptive rocks.

The alternation of dry and humid climatic periods since the Miocene and the formative forces released by them created the long, broad wadis in presently arid zones, deposited the wide plains of the serirs (Serir Tibesti, Calansho) and the dune areas (Ergs, Edeyin) or wore them down and impressed upon the region the character it presents today.

Thanks to the work of oil geologists, three large Palaeozoic-Mesozoic basins have been found in Libya; a fourth one is the Upper-Cretaceous — Late Tertiary Sirte basin. The basins are divided from one another by swells. The Homra Basin is situated in the north west and is delimited by the Nefusa swell in the north and by the Gargaf swell in the south. Numerous drillings into the sandstone horizons from the Ordovician to Triassic proved the existence of oil. South of the Gargaf swell the Murzuq-(Jado) Basin begins between the Tassili-Hoggar in the west and the Tibesti-Haruj swell in the east. Presumably the Palaeozoic to Nubian series (NM) is strongly developed here. East of it the Kufra Basin is situated and extends as far as the borders of Egypt, the Sudan and Chad and embraces large parts of southern Cyrenaica. Probably the Nubian series from the Permian (NM) onwards is strongly developed here. The Sirte Basin is a continuation of the Gulf of Sirte towards the south. Its tectonic development coincides with transgressions from the time of the upper Cretaceous to the Miocene (regressions). It is divided into a series of swells and troughs with a marked tendency to follow a north westerly—south easterly direction (Hun Trough). In parts sedimentaries of the upper Cretaceous, the Paleocene and Eocene contain considerable deposits of oil, a number of which are already being exploited (vide HECHT, FÜRST, KLITZSCH).

3. Water Conditions

Libya is poor in water. As is evident from the meteorological observations, it only periodically receives rain in winter which itself falls largely in coastal areas and only irregularly reaches the interior, which consequently suffers again and again from dry periods when scarcely any rain falls.

a) Dry Beds

Nevertheless, the country is traversed by countless valleys and river beds, proving that in one or more pluvial periods the surface run-off must have been considerable. Terraces on slopes also show that the erosive force of the water has often been strong, although weaker at other times. Nowadays nearly all the river beds are dry; so-called wadis, dry beds, take their course through them, at best carrying water after strong rains have fallen within a limited area and which soon seeps in once more. Often wadi beds can only by recognized by their narrower or wider channels crossing the valley bottom and filled with boulders or sand. The beds are mostly accompanied by a strip of sparse vegetation.

Only a few of the dry beds reach the sea. The majority of them end up in interior basins with interior drainage as in the case of the Fezzan or the wide serir plains; between dunes they peter out in smaller, shallow "grarets" rich in vegetation, or seep in over flat alluvial fans. That part of the periodically-flowing water which does not evaporate here penetrates the porous soil and reaches the groundwater. Only one river in Tripolitania is perennial: this is the Tareglat-Caam wadi east of Homs, which in a length of 90 km. contains a few springs in its upper course enabling a thin thread of water to reach the sea in summer.

Temporary spring or autumn floods fill the wadi to a breadth of 20 m. and others like the Lebda wadi nearby, to a lesser extent. The Megenin wadi which runs into the sea at Tripoli, plunges swiftly through its bed for days as a 30—40 m. wide torrential river but after a few hours the flood has generally slackened off again (Fig. 15).

In Cyrenaica only a few torrents — like the spring-fed Derna wadi, the el Caf wadi, the Latrun and others — exist as perennial streams to bring some water to the sea where it has not been expended in the irrigation of gardens. For such reasons, the waters arriving precipitately, are not only known from the last war. Although it is rare, such short floods occur in the interior as well. A case occurs near Gat in the Izeien or Taneszuft wadis which may swell to 40 m. across without any rainfall occuring in the Gat itself. (BARTH: beginning of September, 1850 and then in May, 1934). This sudden flow off the wadis can and has caused accidents. Even in extremely dry areas the phenomenon can be observed, as for example the Jebel Auenat which can receive so much rain in certain years — supposedly every 7 to 10 — that the entire surroundings are covered by rainwater ponds for days with the result that grass grows all around and bushes become green for one to two years and temporary pastures are created. Groundwater streams follow the larger wadis, as for example the Soffedjin, Zemzem and Bey el Kebir, and come to the surface as large springs in sebkh (e.g. Tauorga) or even in the sea itself.

b) Permanent Lakes of Saline Water

The only *permanent water accumulations of the desert are small lakes of saline water.* They lie sunk into shallow depressions, reaching below their respective water-tables. Due to the supply of groundwater they are able to maintain their level permanently in spite of considerable evaporation. Their size, however, fluctuates somewhat, according to the level of their water-table and if they depend on the rains in their closer vicinity, they are influenced by them. Their depth is generally shallow.

The number of Libya's permanent lakes is small, amounting to some twenty in all. The largest of these lie to the east of Jaghbub in the Melfa Basin in parts which fall below the sea level (up to —29 m.). The Arreskia Lake comprises about 9.4 square km., Lake Fassa

3.3 square km. and the third, Lake Hasi ed Duni, consists of a series of smaller lakes which link up at times.

Better known are the ten lakes (together with some ponds) of the Edeyin Ubari, which, surrounded by bushes and palm trees, lie in the sand desert between sand dunes. At three of them — Mandara Lake (1,000 square m.), the largest (Fig. 16), the Bahar et Truna which contains among other things sodium carbonate and Bahar ed Dud, the "worm lake" — Dauada settlements have been built and there is even a little mosque made of salt clay at Mandara. In spite of the relatively high salt content (MgCl, NaCl, K^-, Ca^-, S^- et al.), some crustaceans, mosquito larvae, algae and the famous daúd = worms (Artemia sal.) live in the lakes. One kind of reed grows on the lake shores and rushes are found in the sebkh and swamps which extend the free water areas. Sweet groundwater may be found by digging in the vicinity of the lakes.

Over the past years Dr. N. RICHTER has investigated the three large lakes (as well as two small ponds) in the caldera of the Wau en Namus volcano (Diameter = 4.5 km.). Soundings were taken, the water temperature measured and the salt content and evaporation determined. The lakes lie at a height of 430 m. above sea level and 100 m. below their surroundings. Their combined size then amounted to a total of 320,000 square metres. Apart from the very saline lake in the south they were ringed about by a dense, c. 4 m. high fringe of reeds which was inhabited by mosquito larvae and coots. On the shores of the very saline lake there was a sparse strip of tamarisks and low reeds only in isolated places. It is lacking in animal life. The analysis of its water showed the following: NaCl 97,720 mg/l; Cl^- 59,210 mg/l; SO_4^{--} 31,451 mg/l (Richter). The salt content of the middle lake only amounted to one eighth of this amount, while the lake in the north is green with algae and was proved to occupy a median position between both of them. Between both the latter lakes sweet drinking water could be obtained at a depth of about one metre. At the southern lake, half a metre away from the edge, a fennek, a small fox-like animal, had dug itself small surface holes which contained drinkable water. A few small palm groves grow at some distance from the lakes on the crater soil (temperatures — see RICHTER, 1960).

The greatest depth of the lakes was found to be 15 to 16 m. and the annual fluctuations of the water-level more than one metre. Measurements of evaporation on the water showed an annual minimum quantity of 5,000 mm., i.e. the total surface of the lakes releases 1.6 million cubic cm. to the atmosphere, hardly any part of which is substituted for by rain. The general watertable to which the Wau en Namus belongs, appears to have so considerable a reserve at its disposal that this annual loss is of no significance.

In the shallow depression of Kufra (el Jauf) there are two small lakes; the Hafun lake lies in the west in a bowl which is sunk about 9 m. deep into the plain. Its shores are steep and sandy and in size it amounts to about 325 square metres; its water-level lies 383 m. above sea level, fluctuating with the groundwater and it is about 3.8 m. deep. The water is clear and has so high a salt content that one may float above the surface without swimming. East of the oasis there is Lake Buema which has similar dimensions. Reeds advance from the more shallow southern shore towards the lake and mosquito larvae, small crustaceans and algae animate the salty water. Close to the north east corner of the lake there is a well with drinkable water which is only slightly brackish (Fig. 17).

A 3.5 km.-long lake of brackish water, surrounded by palm trees, lies at the foot of the small Jebel Bzema.

The remaining Libyan lakes are only small and only a few square metres in extent. There are still two saline pools at the south western corner of the town-wall of Murzuq which facilitate the dispersal of malaria-carrying mosquitoes (Fig. 18). Others have been drained and are now mostly without water. They act as a transition to the sebkh, salt swamps and pans. The oasis of Elbarcat near Ghat and several others (6) near Traghen and Tmessa in Fezzan contain further lakes and pools with sweet water. At both places there were warnings not to swim since it was known that the lakes harbour Bulinus contortus snails which act as hosts to bilharzia. The lakes formed by artesian springs, such as those at Brak, Gira, Agar, and Gadames as well as the small lake of the Rumia Gorge (Jefren) and the one at Farga near Jado, ought also to be mentioned.

In the south west of Ghat in the Tassili and on the way to Janet, small sweet water wells have been observed in rock basins having neither intake nor outlet and fed by rain or, as the case may be, by temporary springs in the vicinity. They lead to the "Galtet" — protected water holes full for the main part of rain-water, which tend to dry out easily when supplies are inadequate.

Such temporary rain-water pools are also often found in places where water cascades over steep walls into a wadi and excavates a pothole in narrow gorges protected from the sun. They are also to be found in the Haruj for instance in natural depressions in the rough basalt terrain where rain often accumulates to a depth of 50 cm. following rainfall. In 1963 large basins in the west of the basalt mountains were even filled to a depth of 2 m. by rainfall. As it dries out the soil cracks into polygons but scarcely ever becomes covered by salt crystals. Following rains shallow and in parts extensive rain water pans may be seen for a short time in the Hamada el Hamra (Fig. 19).

c) Sebkh and Salt Swamps

Much more widely spread than lakes are *sebkh* and *salt swamps*. In their deepest parts saltwater can often be found, increasing the size of the lakes during the rainy season and especially so near the coast — i. e. still within the area of salt steppe. As it dries up a white salt crust crystallises out on the clayey, muddy soil and the dry loam surface cracks up into large polygons. Sebkh of this sort can be observed on the north-west border of Libya, west of Zuara. From the coast they extend at times as deep as 50 km. into the interior. Surrounded by low bush vegetation, they form extensive, slightly saline lakes in winter and grey, muddy salt-swamps during the transitional period. Even the groundwater of small wadis, which, coming down from the 80-km.-distant Tripolitanian Jebel, seep away on the flat detritus fans in the foreland, come to the surface once more in them.

These sebkh signify the transitional form to the winter lagoons, following the coast in those places where it is formed by a belt of dunes. They are narrow and tend to assume an oblong shape, their salt-clay soils often carrying a sparse dwarf-bush vegetation. Towards the interior they widen out considerably in places as in the Mugtaa

Sebkh in the mouth of the Farigh wadi (Cyrenaica) or as in the largest of them — the Tauorga sebkha (2,500 square km.). In the Tauorga sebkha the groundwater streams of the large Soffedjin and Zemzem wadis end in large, strong springs as do those of the wadis coming from the Jebel Tarhuna.

A number of smaller and larger sebkh lies in the transition zone to the desert, mostly in shallow depressions (grarets) in which the outflowing waters of wadis or groundwater streams come to an end. Thus static surface water in small pools can only rarely be seen here. Flat or hard, grey clay fragmented into clods covers the soil, which looks like a ploughed field. Below the salt-clay the soil is damp. Larger grarets like that of the Geizel (Cyrenaica) are traversed by small wadi beds frequently cut into the salt-clay. Lines of dunes shift across them while small islands stand out from them or at times, as in the case of the Geneien sebkha (512 square km.), large parts are completely covered by sand with the result that the character of the sebkha can scarcely be recognised. Immediately adjacent to the sebkha sweet water is often found at a shallow depth — e. g. below the ruined fort of Sahabi der Bir Ressen.

Greater numbers of sebkh are strung together in the long valley-furrows of the Fezzan, e. g. the Adjal wadi, the es Shati wadi and other valleys (Hofra, Hecma). For instance, the green strip of vegetation, which follows the Adjal wadi between Ubari and El Abiad, is 150 km. long; sebkh alternate with palm-tree oases or strips of bush, and sweet-water wells provide the opportunity to establish gardens and villages. Apart from the salt pans there are also gypsum secretions ($CaSO_4$) in gypsum pans as for example near Socna, Hon, Jofra, and other places.

Concentrations of salt in the sebkh are caused by the continuous supply of vadous water and a strong, continuous evaporation. Analyses have shown that NaCl and MgCl are generally predominant but salts of K^- and Ca^- are also present.

d) Groundwater and Sources

Apart from the water resources mentioned so far, *groundwater* is also accessible by *springs* and *wells*. Isolated areas of Libya, even in the desert, are rich in springs; in the north there is, for instance, the spring-line at the foot of the Tripolitanian Jebel from Tishi (Tiji) to Bu Gheilan and also the Tauorga sebkha. In the Fezzan there is the area around Brak which deserves especial mention [Wadi es Shati between Maharuga and Gira with 227 springs (Italian register)] or the coastal area of the Jebel Ahkdar where a number of giant springs is to be found. The springs of the desert are mostly contact springs, quartz sands being the aquifers, clayey-marl rocks the impermeable retainers. Often the water appears alongside a spring-line, runs a short distance and evaporates or seeps into a vegetated spring-swamp. The Libyans dam the water with a low wall almost immediately after its exit (Fig. 21) and lead it through a channel for purposes of irrigation; they often excavate the spring so that the water emerges at the bottom of a small crater (Fig. 20). In the Fezzan, and particularly in the Adjal wadi, water flows off the Nubian strata of the Mesak Settafed of the Serir Murzuq and Um Alla (588 wells). Even the Garamantes had dug long tunnels, the so-called foggaras, through the detritus fans of the wadis towards the scarp slope and collected the water by captation underground and ducted it towards the oases in order to irrigate their gardens. At the present time all the foggaras appear to have collapsed here and there is, moreover, nobody left who might know how to clean and repair them. Only a few oases like Zella or Zuila still keep some in operation.

On the plateau of the Jebel Akhdar the relatively flatly deposited upper strata of the Tertiary limestones allow the water to percolate fast. In this area which receives ample rain (500—600 mm. annually) karst rivers have developed deep down chiefly on clayey and marley series which, cut through in various places by erosion, come to light as giant springs. Best known of these is the Ain Schahat, the ancient spring of Apollo which continues to the present day to supply the Cyrene settlement with water. The Ain Mara, the spring-line of which (6 well chambers) is tapped at a height of 350 m. above sea level, the springs of which supply a flow of 70 hl./sec., is to be used to irrigate the eastern district with its water.

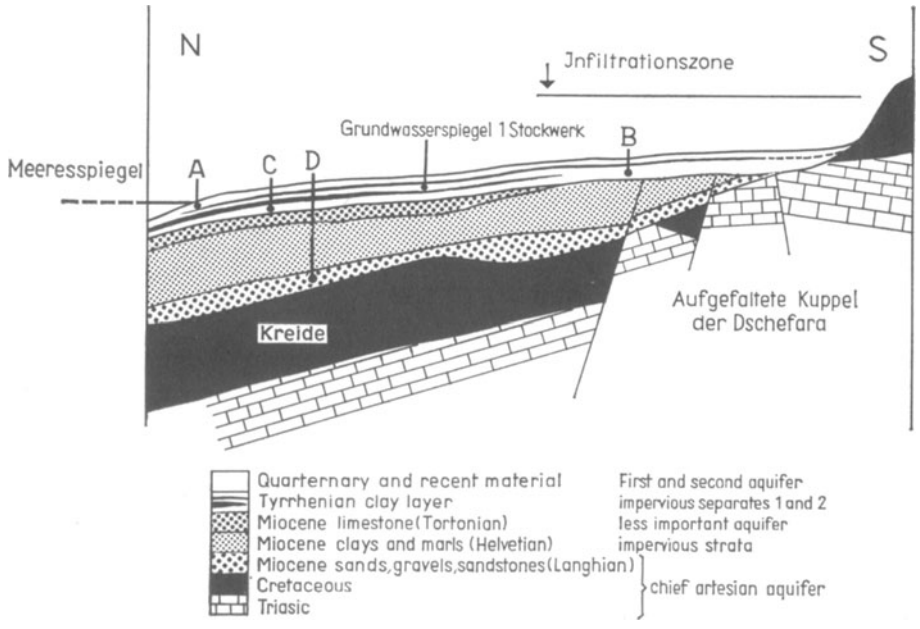


Fig. A. Groundwater bearing parts of the soil of the Jefara Plains. [According to Desio, Chiesa, Viali, Lipparini, Archambault et al. (in Hill).]

Types of wells:
wells with water

A from upper quarternary
B from continuous quarternary
C from deeper quarternary
D from artesian ground-water

} Ground-water level

The Ain Mansur of the Derna wadi supplies the town of the same name; the water of the el Bilad spring from the same wadi has been ducted as far as Tobruk. The largest karst spring is the Ain Debussia south of Latrun; its water is to supply Beda, Messa, Barce and their environs (Fig. 22).

The ancient settlers have left behind a great number of cisterns on the plateau which continue to collect rain water even at the present day. The large town cistern of Tolmeta (Ptolemais) with a capacity of 6,500 cubic metres has become very well known; it receives its water from a perennial spring of a 1 litre/sec. flow. In the 6th Century it was renovated once more by Justinian and was used for more than 1,000 years and is now in the process of being cleaned out again (1965). Apart from these there are still other smaller springs in the Jebel Akhdar.

North of Benghazi a giant spring, the Ain Zeiana, comes out at the edge of the lagoon which carries the same name. Not far from there water fills a row of subsidence dolines in the coastal plain; e. g. the el Mgarin lake, the "Rommel" lake. Underground streams which come from the Jebel can be seen in the Lete doline and feed the wells of el Guarsha and el Coefia or get blocked up in sebkh near the sea (e. g. at Gariunes). From the vicinity of Benina karst water is taken to Benghazi nowadays. East of er Regima as well, prolific water has been found recently.

Wells have been dug in all areas in which the uppermost water-table reaches to just below the surface (Fig. 23), firstly for the supply of the population and secondly for the irrigation of the oases (Fig. 25—27). As mentioned above, adjacent to sebkh and salt lakes the water is often sweet or at least scarcely brackish and may be drunk. Irrigation agriculture requires a continuous flow of water, even if by means of underground pipelines so that the soil does not become over-saline. It may be necessary to remove the upper salt-crust (Fig. 24) in order to use the soil once again (Fezzan).

In the Jefara where the natives near Tripoli lifted the water in the oases from a depth of about 4—6 m. with dalu (scaffolding over wells, manual operation and donkeys) the upper Quaternary water-table in the southern area was opened up by about 8,500 wells as a result of the Italian settlement (Fig. A and B). Now wind motors and electric pumps are also being used (only 17% are worked by dalu). The farmers were generally satisfied with 3—8 cubic metres/h. water for one hectare. A second Quaternary water-table of equally good quality was opened up for the water supplies of the town and the larger Italian settlement schemes as the mechanical pumps soon made too much use of the upper water-table. The quality of the second one is only impaired where overpumping takes place near the coast when sea-water is drawn in instead. It is divided from the upper one by Tyrrhenian clayey sediments. The deeper artesian groundwater (3rd horizon) from Miocene strata is, however, of such inferior quality that it is useful for cattle and irrigation purposes only with the admixture of good water. These artesian wells can be found frequently in the eastern Jefara, especially around Tripoli. As soon as demands on the first and second water-tables are causing strain through the use of oil pumps the problem arises of how to replenish them. In any case a general fall of 4—8 m. in the water-table over large areas has been observed in isolated places, e. g. near Ben Gashir by 14—16 m. (since 1930). According to observations the Quaternary as well as the Miocene artesian water-tables are supplied by rain water which fell in the Jebel and its foreland. The damming, diversion and splitting up of the Megenin wadi floods after it leaves the mountains are hoped to not only allow the irrigation of the soil for agriculture to take place but also to supplement the groundwater. In the western Jefara where less groundwater exists and the Quaternary water-table lies deeper down, cisterns had to be built to collect rainwater running off on the surface.

Even in those areas of the Fezzan which are not rich in springs (see above) additional water supplies have been opened up by the French; amongst other such supplies, artesian water from deeper Nubian strata. Thus it ap-

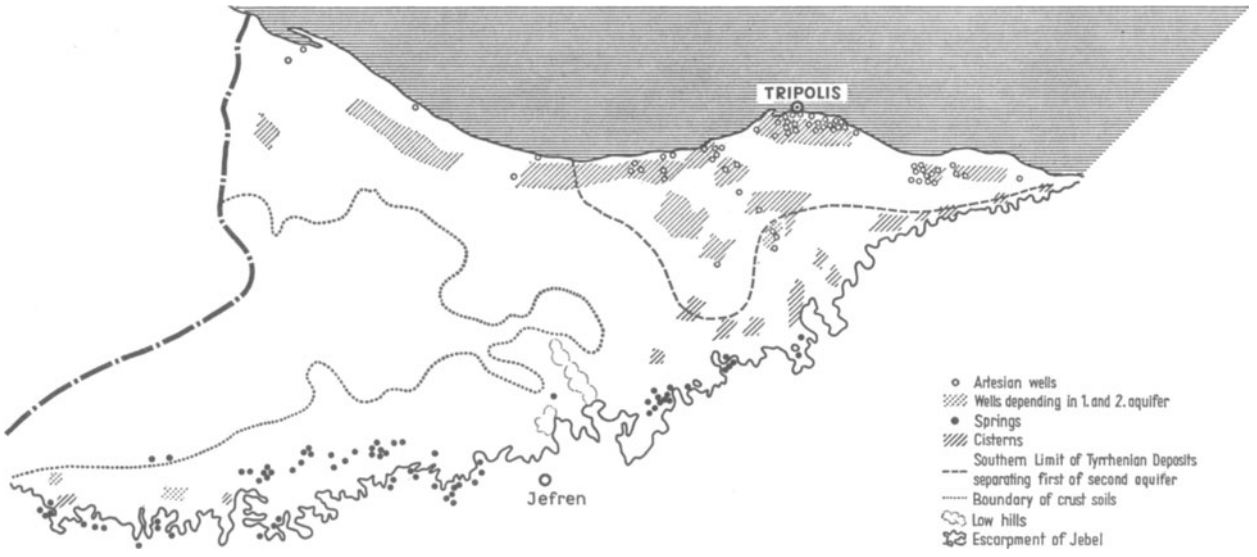


Fig. B. Water deposits on the Jefara Plains (according to Willimott and Clarke in Hill).

pears that in the first place the groundwater network is rather excessively exploited; secondly, there is too much water there which, due to the small differences in soil,

does not run-off sufficiently when irrigated so that near Brak, for example, over-salting of newly laid-out rice fields due to evaporation and the rising of water in house walls in the village are unpleasantly noticeable. The closing down of most of the new wells is said to have redressed the balance. On the whole an increase in the depth of groundwater from east to west is observed in the es Shati wadi and the Adjal wadi and amounting to between 1 and 20 m. in the former so that a groundwater stream is supposed to run from east to west, thus effecting an increase in salts as well. NaCl, MgCl, Ca^- and rather less S^- as well as oxides and hydroxides of iron (es Shati wadi and near Serdeles) occur in varying concentrations throughout the Fezzan. The highest salt content (Cl 7.1) is said to be found in the well at Brak fort. On average the water of wells near Ghat contains fewer Cl compounds than further to the east (Fig. 7).

There are still large gaps in the detailed knowledge of the groundwater situation in the interior of Libya. It is likely that in the Fezzan as well, there is no continuous water-level. Some wells, for instance, dry up during great droughts while others persist. Deep drillings have often established varying clay layers above which water was found at depth, the existence of which is ascribed to infiltration. In spite of poor rainfall local pockets of water form in the dunes by slow replenishment. Wells of variable efficiency are often found on their margins.

The Hofra (southern Fezzan) receives its water from the Serir el Gattusa and the Jebel Ben Gnema; the latter also supplies the Hecma wadi.

The Kufra Basin is supposed to get its groundwater in part from Tibesti. In any case it has fair water at its disposal throughout. The salt content of the wells at El Gof for instance is low. Analyses at 4 m. depth in wells showed a Cl^- content of only some 0.3 g./l. from sandstones, whereas nearer the sebkha and at a depth of 1—2 m. the Cl^- content amounted to 0.8 g./l. The quality of water beyond the et Taj oasis is still better: the chlorine content from wells 13—16 m. deep reached a level of only 0.05 to 0.1 g./l. The remaining oases of the Kufra region too have good water on the whole, even if, as in the case of the Tazerbo one with an 0.7 to 2.1 g./l. Cl^- content, some wells are somewhat more markedly saline.

The Jalo oases are comparatively worse off. At el Ergh the salt content of the wells fluctuates between 1.95 g./l. to 3.5 g./l. Cl^-; in certain wells in Jekerra which are 7 to 12 m. deep, it even rises to about 8.85 g./l. together with additional calcium, magnesium and sulphates. Near Bettafal, the content at a depth of one m. has a level of only 0.56 Cl^-.

Wherever the water-table remains well below the surface the number of wells is small. But even in such areas they seldom reach down more than 30 m. (Sarra well — 68 m.).

Tmeds are found at times in wadis; these are small, sub-surface accumulations of water located in cavities in the rocks which have been infilled with sand or detritus which prevent the evaporation of the water.

Such water may often remain in the depressions for years.

The maps 5 and 6 which have been included, are of the United States Agency for International Development and show the approximate depth of the groundwater level below the surface of the land as well as the chemical quality of the same.

Water situated relatively close to the surface is found in the geological basin of Sirte, in the Kufra basin, in the Fezzan basin and in areas near the coast. The water lies deepest in the Miocene limestone areas of the Jebel Akhdar — except where it forms karst water reaching the surface as springs in deep wadi valleys — as well as in the rear of the Tripolitanian Jebel, in the Hamada el Hamra (Paleocene limestones) and the western edge of the Sirte Basin (Miocene limestones).

In these areas the most over-saline water is also found. The deeper the strata from which it comes, the more saline it is. Surface waters of relative sweetness are generally provided by ridges in the vicinity such as the water of Brak by the Jebel Fezzan and the Gargaf (W. es Shati), and the water of the Adjal wadi by the steep scarp of the Mesak and the Murzuq serir. The groundwater of the Tripolitanian Jefara stems from the Jebel Nefusa, the groundwater of the north-westerly coastal plains of Cyrenaica (Barga el Hamra) and the adjoining north-easterly coastal strip, from the Jebel Akhdar.

4. The Climate

The Libyan climate is determined by the contrast between the Mediterranean and the Sahara. Between the sea and the desert, a coastal belt follows the coast and this receives more considerable rainfall. A 3—5 km.-wide section of this belt immediately bordering the coast is more intensely affected by humidity and winds from N. W. to N. E. with their influence on temperature and precipitation; i. e. it is more intensely affected by the Libyan-Mediterranean coastal climate. This section is succeeded by still relatively humid strip of coastal-steppe climate in the plains and low hill country in Tripolitania and Cyrenaica but which is lacking in the Sirte and which passes into a continental steppe climate towards the interior. In the Sirte it nearly reaches the sea. It is distinguished from the former by increasing temperatures and decreasing precipitation. It is from this zone that the plateau of the Tripolitanian Jebel and Jebel Akhdar rise; both are over 800 m. high. There is a cooler and more humid altitudinal climate which resembles that of the Mediterranean especially in the more humid upland of Cyrenaica. Towards the south it is followed by a transitional strip to the desert, the predesert climate causes the continental steppe (salt-plant steppe) to grow poorer with decreasing humidity, i. e. increasing aridity and temperatures rising further, and pass over to desert flora. A few higher mountain ranges rise from the desert fringe (Jebel Waddan, 650 m.), showing slight deviations in the increase of rain and temperature and thus converging on the steppe climate. On the whole the 50 mm. isohyet can be regarded as the borderline of total desert. Even then some higher mountains in it like the Haruj (1,200 m.), Jebel Fezzan — Nab el Geru (1,500 m.) and Jebel es Sauda (800 m.) receive somewhat more rain. High-mountain steppe only developes outside Libya in the Tibesti at heights to 1,800 to 2,000 m. Coming from Egypt, a wedge of extreme desert advances towards the west to the Jebel Ben Gnema and distinguishes itself by diminishing rainfall and very high rates of evaporation with practically no vegetation. As far as the climatic process is concerned the areas near the coast are better known than the desert-like interior which has but few observation stations (Maps 7—11).

a) Steppe Climate

The greatest contrasts are marked by the winter and summer of the steppe climate, the winters being mild and richer in rainfall, the summers being hot and deficient in rain. The transitional periods between these seasons are but short. At the *start of winter* the belts of the horse latitudes with their high pressure gradually move south and, originating from the Azores south of the Atlas Mountains and on the plateau of Shotts, they form a zone of high pressure with a smaller area of high pressure over the Ahaggar extending before it. The pressure gradient reaches from them both to the tropical belt, i. e. the N. E.-Passat which blows from the Mediterranean into the country during summer is being moved further south into the Sahara. It is now replaced by winterly depressions which advance from the north west to the North African coast moving along the polar front to the east and bringing humid Atlantic air towards the east. The beginning of October tends to still be warm and fine with cooler sea breezes reducing the heat. Soon, however, dark clouds mass together over the sea and sheet lightening is to be seen from afar until after a few days the clouds draw near to the coast to give the first thunder burst accompanied by heavy rain. A hot, close wind from the south (Gibli) usually blows on the preceding day. With this autumn has commenced. Thunderstorms with rainfall occur repeatedly, possibly together with varying southerly and north-west to north-east winds for several days then often to be followed by weeks of fine, pleasant weather with morning fogs forming at the coast until the rains return for another period of several days. Thus the weather continues to alternate until the beginning of the rainless summer. In Cyrenaica rainfall usually starts somewhat later in the coastal plain. Clouds begin to form over the Jebel Akhdar even earlier but at last the north-westerly storms bring the first rains which are important for the start of the sowing season in agriculture.

The amount of rain is not very high. Only Tripoli (since 1879) and Benghazi (since 1881) possess longer series of observations and only a few of the remaining places go back further than 1914. With 54 rain days the mean annual precipitation of Tripoli amounts to 370 mm. (Sidi Mesri 382 mm.). Fluctuations from one year to another are, however, considerable: there has been over 750 mm. and under 160 mm. per annum. The amount falling in 24 hours can easily attain 100 mm., i. e. one quarter of the total to be expected falls on one single day. On such occasions the lower parts of roads in the vicinity of the town are under water for days.

Tripoli is situated on the coast. The rains decrease towards the interior and Azizia (coastal-steppe climate) receives a mean annual rainfall of only 214 mm. Towards the Jebel foreland in the south as well as towards the Tunisian border the amount of rain decreases even further (Tigi, 140.4 mm.); only the Jebel increases it once more to a mean of up to 322 mm. in Garian (fluctuations between 510 and 63.5 mm. have been recorded), to 138 mm. in Nalut in the west and 321 mm. in Cussabat in the east. The southern plateaus show a decrease in rainfall. The mean annual rainfall of Misda is only 62 mm., Beni Ulid 58 mm. The highest annual total recorded here has not been over 200 mm., the lowest 22 mm. and 9.2 mm. respectively, indicative of the location near the desert fringe. Notwithstanding this the dark clouds from the north-west are most impatiently anticipated here as well, bringing as they do the autumnal rains which, however, sparse they may be, still permit the nomads to till their poor fields in the wadis.

The temperatures in Tripoli show in *winter* a mean of 12.3° C., the January mean being 9.3° C. This in turn shows fluctuations between 3.1° C. and 23.5° C. — in other words the winter days are quite tolerable. The mean temperatures in the hinterland are somewhat lower, amounting to 10—12° C.; the daily fluctuations, however, are somewhat greater. In the highland with its mean January temperature of 8° C. the thermometer may occasionally fall below freezing point; in the early hours of the morning temperatures down to −15° C. have been recorded in Garian. At times even in winter a Gibli (southerly wind) may rise up and can push the thermometer to above 35° C. for a short time.

In *the Sirte region* towards the east the amount of rain decreases (Sirte: yearly average 177 mm.; Agheila 97.8 mm.; Ajedabya 130 mm.) but it increases one more in the plain west of the Jebel Akhdar in Cyrenaica. Ghemines has still 191.2 mm., Benghazi already some 258.8 mm. Here, too, the fluctuations from one year to another are considerable, the highest total being 489.2 mm., the lowest 118 mm.

Towards the *mountains* a quick rise in the values can be observed. Barce (el Merj 282 m.) receives 484.7 mm. as a mean annual total, subject to annual fluctuations from 773.3 mm. to 208.3 mm.; Messa which is already on the edge of the plateau, receives 649.9 mm. and Cyrene (621 m.) 595.5 mm. in 59 rain days with a fluctuation between 1,348.8 mm. and 278.4 mm. Towards the east the amounts of rainfall decrease equally fast. In Derna on the coast the mean annual rainfall total 285.2 mm., in Tmimi which is situated in the rain shadow of the Jebel Akhdar, it is only 74.6 mm. and in Mechili on the southern slope of the mountain a mere 56.4 mm. In the Marmarica the decrease in rain continues towards the east: Tobruk's annual mean amounts to 145.7 mm. and Amseat in the steppe near the Egyptian border has only 60.4 mm.

With 11—12° C. the mean temperatures for January are somewhat higher at the coast in Benghazi than in the west, but on the plateau they reach about 8° C. (Cyrene 9.2° C.). Here as well as in the Tripolitanian Jebel, occasional snowfalls may occur.

The last of the winter rains fall in March or even April. They are generally cold and dreary but saturate the soil with moisture once again. Now the steppe, where it has received rain, begins to blossom but for the ripening of crops and their yield it is of no value. The belt of high pressure from the horse latitudes gradually shifts to the north and a Saharan depression forms south of the tropic and the north east passat succeeds, bringing with it the fine summer days. But soon the hot, southerly wind, the Gibli, starts here and there to blow from the desert to the steppe, initially for only short periods but soon for several days at a time to interrupt the calm days of the trade winds. Only rarely do the winds meet to set off short, localized thunderstorm rain which often fails even to reach the ground. For months *summer* can continue without any rain whatsoever. If the spring rains fail or are only poor the cereal crops are badly damaged. In the coastal regions at least the formation of morning fog or dew as a result of considerable radiation-cooling by night may provide some relief from drought. The average rela-

tive humidity at Tripoli amounts to about 65 per cent., in the coastal plain to 60 to 40 per cent. With the Gibli it may quickly fall to 20 per cent. and below.

As an example of occasional droughts the years 1927 and 1928 will be considered. In Tripoli the annual rain total was 196.7 mm. in 1927, the period from November to May including 187 days without any rain. The 220 dry days in the period continuing from the start of April, 1928, until November, 1928, was only broken by a few isolated days of rainfall. The total amount of rain in the year 1928 reached 341.5 mm. The following years as well were struck by periods with over one hundred days without rain and annual totals below the average. Similar arid periods are also to be observed in the Jebel and in Cyrenaica.

In Tripoli the mean temperatures in July are about 26.7° C. In the early morning hours the thermometer stands at 18° C., climbing to 32—33° C. in the course of the day. The north-east wind prevents the temperatures from becoming unpleasant. Only when the north-east wind drops the skies cover over with stratus cloud and a slight southerly air streams gets up, life becomes unpleasant and hot. Soon the Gibli increases and fine dust obstructs visibility. The temperature, accompanied by enervating sultriness, gradually rises to 40° C. and even to 45° C. After one to three, sometimes up to 7 days the storm usually dies down and the wind backs to the north-east, the atmosphere is speedily cleansed and once again the skies radiate a bright blue. Plantations suffer greatly from a prolonged subjection to the southerly wind because of the greatly reduced relative humidity. Leaves wither and crops are destroyed.

In the coastal plain temperatures behave in a similar way and even in comparison with the Jebel the differences are not remarkable. The Cyrenaica highland has somewhat lower temperatures on average (Cyrene: mean July temperature 23.7° C.) rarely rising above 25° C. and 26° C. during the day. This somewhat cooler highland climate is well liked as a recreation area by the European families from Benghazi.

Average Temperatures:

Tripolitania		
Tripoli	Jan. 12.0° C.	July 26.3° C.
Homs	Jan. 13.2° C.	July 26.2° C.
Azizia	Jan. 11.3° C.	July 28.7° C.
Garian	Jan. 8.3° C.	July 26.5° C.
Nalut	Jan. 7.8° C.	July 27.9° C.
Cyrenaica		
Benghazi	Jan. 13.5° C.	Aug. 26.3° C.
Derna	Jan. 13.3° C.	July 24.7° C.
Cyrene	Jan. 8.5° C.	July 23.7° C.

b) Desert Climate

In the desert too, there is winter and summer with short transitional periods in March and October. *The winters* are characterized by warm to cool temperatures which can fall below freezing point on certain days in the mornings, and irregular, mostly short, malignant rainfalls which rarely last as long as a few days and decrease towards the south-east and east. The hot summers are almost rainless. Evaporation is particularly high in summer. While relative humidity still amounts to 50 to 40 per cent. in winter, it falls to an average of 30 to 20 per cent. and below in summer. At times it may sink below 5 per cent. for a few hours.

Offshoots from wandering depressions move from the north-west as far as the desert. Until the clouds break up they still bring rain to the Fezzan and even to points as far south as the tropic. If northerly and southerly airstreams converge they readily give rise to thunderstorms which may break with heavy rainfall on the Hamada plateaus so that extensive rain lakes form (October, 1937). Mountain islands and prominences trigger off thunderstorms as well and bring rainfall on their western and northern sides.

In November, 1958, there were thunderstorms with strong rains over the Jebel es Sauda and the Haruj, and in the same night strong downpours fell along the scarps of the Mesach Settafed and ran into the Wadi Adjal, destroying the village of Gagra. In the southern Hamada el Hamra rain fell in January, 1962, which could be traced in parts as sleet as far as Edri in the Shati wadi. At the same time snow had fallen in the Jebel es Sauda. In November, 1937, a heavy thunderstorm raged during the night in the area from Edri to Brak and including the southern sand desert (Edeyin Ubari). Houses collapsed in Maharuga and Agar. North-west winds extend as far as Ghat where the rains fell over Tassili, the Akakus and Tadrart and made the wadis swell there (January, 1933). In 1841 VOGEL experienced seven days of rain near Murzuq, in the vicinity of which the flooded wadis caused considerable damage; Dr. RICHTER experienced a 24 hour-long rainfall at the western end of the Haruj and I myself several thunderstorms on this plateau in November, 1937. Such storms are of great value for cattle raising and rain agriculture amongst the population of the vicinity.

In the autumn months of the year 1963, such strong rains fell in the western Haruj that large basins were filled to about 2 metres depth and wadis carried water for up to four months. In the same year floods, which came down from the Jebel Waddan, destroyed the newly asphalted road between Bu Ngem and Sebha in thirteen places.

Amounts of rainfall measured at stations closest to the area (according to MAGAZZINI):

	October 1963	January 1964	February 1964
Sirte	69 mm. 12 days	86.8 mm. 12 days	63.7 mm. 3 days
Hon	26.9 mm. 5 days	0.2 mm.	0.6 mm.
Sebha	37.2 mm. 5 days	0.0 mm.	0.0 mm.

In February, 1958, there were rather violent thunderstorms in northern Tibesti. Such storms are probably caused by the formation of shifting minima in the border zone between harmattan and monsoon, which cross the Sahara on the way back and make contact with the central mountains.

In the south-west of the Libyan desert not every year but at least on frequent occasions, extensive and also localized rains occur; these are mostly noticed by travellers rather than by one of the few observation stations in the oases. The quantity of rain falling in the open desert can scarcely be determined. It can, however, be

said that precipitation decreases further towards the east of the country. In December, 1957, for example, there were light falls of rain north of Jalo. HASSANEIN BEI reports that a few drops of rain fell in the Calansho Serir on two occasions in March, 1926. A few drops fell on Rebiana in January, 1958. Clouds drifting to the north were seen shedding rain without its ever reaching the ground. On the other hand, heavy rain is known to have fallen in the southern parts of the Auenat mountains in 1927 and this flooded the lower parts of the country by draining off the wadis within a radius of 25 km. From Erdi to Kufra cattle were brought here to graze. In 1928 summer rains fell once more but in 1931 the region had to be deserted because of the lack of water. Only in 1934, 1937 and 1954 considerable precipitation occurred once again. Surprisingly high, however, was the amount of dew falling in the most extreme deserts west of Kufra between December, 1957, and February, 1958, which could be observed every second or third day and at times on several successive days. Dew fell in the Kufra oasis itself. In March it diminished fast. In winter the skies are rarely absolutely clear but are often covered by high stratus clouds or by cirrus together with small cumulus clouds (passat clouds) which drift with the wind towards the south-west. The wind shifts from north-west to north-east or east and even southerly winds blow for shorter periods. During the day the wind blows continuously in the desert, growing less towards the evening before picking up once more until the morning when another break occurs. Should the breaks not occur or too strong a wind come, the conditions gradually get on the nerves of those central Europeans who travel without a motor-car or tent.

Apart from the days of the Gibli, winter temperatures are rather pleasant in the desert. During the daytime they remain between 5° and 8° C. and 18° and 22° C., possibly climbing to 25° C. on warm days and only being pushed into the thirties by the Gibli. In the morning hours of fine passat days the temperatures fall below freezing point at times (east of Gadames to minus 6° C. in January, 1962). But the warm sunshine soon makes the thermometer rise again. In any case the daily fluctuations do not exceed 35 degrees.

In *summer* the north-east trade blows across the Libyan desert area with alternative easterly winds at times, particularly in the south-eastern parts. Their influence maintains the fine weather with predominantly cloudless skies and temperatures between 18° and 20° and 35° and 40° C. The cool of the evening to 25° to 28° C. is pleasant and promises a good night's sleep. Only when temperatures fail to drop below 30° C. at night does life become trying. In such cases the Gibli soon gets up as well and brings vehement hot gusts of wind, depressing sultriness and the darkening of the skies by dust. Temperatures rise to 45° C. and even to 50° C. and are said to have reached 55° C. at times. Great relief greets the fresh winds from the north-east after the lapse of a few days and the calm, if hot, summer weather which makes dust cones travel across the wide plains at midday when the air shimmers and creates a fata morgana.

Although the warm thunderstorms with their short rainfalls are rare in the north traces of them were observed by me in the south in July in 1942. At the foot of the northern scarp of the Amsach Mellet to the west of Ubari, depressions in the beds of torrents were freshly filled and near Serdeles a strong, localized thunderstorm with heavy rain which lasted for ten minutes, took us by surprise. The rains probably owe their existence to the influence of the monsoon which periodically asserts itself even north of the central mountains. The summer rains around Auenat in 1928 appear to have been caused by it.

As a result of strong winds, so-called "dry fogs" were observed at some distance from them, moving only very slowly and covered the area — in 1937 near Waddan and in July, 1942, in the Tanezzuft wadi — in dust for a while.

In addition there is still a series of observations made at the official stations situated in the oases and widely separated from one another. They demonstrate that even in the desert the amount of rain fluctuates considerably.

In the Fezzan some years and many summers are without rain although there are some years when the entire annual precipitation falls in summer.

Rainfall totals in the Fezzan

	Yearly average	Fluctuation
Ghat	13.1 mm.	37.5 and 0.1 mm.
Ubari	11.9 mm.	39.3 and 0.5 mm.
Brak	10.4 mm.	19.0 and 0.0 mm.
Sebha	8.3 mm.	30.3 and 0.0 mm.
Murzuq	8.4 mm.	30.9 and 0.0 mm.
Gatrun	5.0 mm.	
Kufra	0.7 mm	2.5 and 0.0 mm.

Rainfall totals in the northern desert

	Yearly average	Maximum	Minimum	Rainless *)
Gadames (western Hamada)	29 mm	145.6 mm.	6.0 mm.	6 months
es Shueref (eastern Hamada)	45 mm.	145.6 mm.	12.5 mm.	6 months
Geria es Shergia (Hamada)	34.9 mm.	73.5 mm.	6.7 mm.	8 months
Aujila (eastern Sirte)	11.7 mm.	42.0 mm.	0.2 mm.	11 months

*) successive months in the year

Towards the east a continuous decrease in the rainfall total can be observed.

The following table shows *temperature performance:*

			Mean	Minimum	Mean	Maximum
Gadames	January mean 10.7° C.	Ubari	January	2.4° C.	July	41.9° C.
	July mean 34.2° C.	Brak	January	1.3° C.	July	41.9° C.
Jaghbub	January mean 19.1° C.	Sebha	January	5.3° C.	July	39.6° C.
	July mean 39.2° C.	Murzuq	January	3.9° C.	July	42.4° C.
		Gatrun	January	2.7° C.	July	43.6° C.
		Kufra	January	4.0° C.	July	45.5° C.
		Kufra	absolute minimum	−2.0° C.	absolute maximum	52.0° C.

5. Vegetation

a) Mediterranean Steppe

The Libyan coast is accompanied by a 100 to 30 km.-wide belt of Mediterranean steppe which, towards the south, is gradually infiltrated by African elements which herald the transition to the desert. Apart from soils and the distribution of temperatures, the steppe depends for its development on the amount of precipitation available. In formation and distribution it generally adapts to the climatic zones.

The appearance of the steppe changes with the seasons. During the summer months it gives a grey and dissicated impression; the wide-spreading and thorny bushes stand far apart from each other, for the most part on low, sandy hummocks, and on stony terrain there are only isolated, dissicated dwarf shrubs. Where they exist at all trees grow only in shallow depressions in which the reddish-brown, loess-like soil lies nearer to the groundwater. There are acacias, and here or there a palm tree or pistacia which add a dark, dusty green to the scene. Only after the autumnal and winter rains from about January to April does the steppe become lusher; herbs and grasses shoot up and, unless the spring rains fail, a lush carpet of plants with white and yellow flowers with some red and blue splashes of colour between, soon covers the ground. Even the thorn bushes produce hard, dark-green little leaves and are decorated with small multi-coloured blossoms. As the sun rises and temperatures increase the splendour of the spring flowers is soon over. For a short time dried-up grasses and herbs can still be seen and the steppe puts on her grey summer dress.

Camel thorn shrubs (Zyziphus lotus), the Calycotoma thornbush, mugwort plants (Artemisia), tamarisks, acacias and gorse-like plants like Retama Raetem and Ginestra tripolitana, joined by bulb plants like Asphodelus, the sea onion (Chenopodiacae) and other herbs and grasses in the spring, form the steppe of, for instance, the Jefara near the sea; in parts on loess-like, water-retaining soil it is denser, in other parts where limestone crusts are already near the surface or dunes shift across the plain, it is sparser. The dunes are fixed by man; a loosely-grown bush of eucalyptus, Australian acacias, pines and tamarisks have been planted here. Eucalyptus lines the roads in settled areas too and together with tamarisks as hedges they become a shelter for the plantations and fields (wheat, barley, lupines).

Towards the Tripolitanian Jebel the steppe becomes poorer, the soils worse and partly decked with detritus and naked limestone crusts come to the surface. The steppe is sparsely strewn with hummocks, hillocks of up to one metre in height, on which camel thorn grows, wide stretches allowing only a sparse growth of dwarf shrubs and extensive areas being covered by halfa grass (Stipa tenacissima) and esparto grass (Lygeum sparticum).

In the coastal strip which is strongly influenced by the sea and situated behind a low cliff or dunes there, is a row of salt-water lagoons and salt swamps with extensive oases stretching between them. The salt pans are surrounded by a fringe of salt-loving plants, different salicornias, belbel which the camels like to eat (Zygophyllum album), Halocnemum and others, herbs and tough grasses, some of which grow as far as the dunes. Here also the red-flowering Cynomorium coccineum grows, a powder from which is used for spice and medicine. Low bush, tamarisks, and acacias advance to the palm oases where, apart from palm trees, figs, apricots, almonds, bananas and citrus fruits are cultivated. Garden fruit, grain and lupins ripen in the irrigated fields.

Similarly with but small changes, the coastal strip continues towards the east. In the Sirte area the coastal belt narrows to about 30 km. Shortly behind the strip of sebkh and dunes the sparse bush changes to dwarf-shrub steppe, interrupted here and there by smaller and larger salt pans with salt-plant steppe. Only rarely can a small oasis be seen in the coastal strip, the palms and gardens of which — as near Sirte — follow the dry bed of a wadi.

Only on gaining Cyrenaica does the steppe belt widen once more and become more humid. Bushes with small spines (Poterium spinosum) lead into it. Extensive areas towards the lower scarp of the Jebel Akhdar are covered by esparto grass while fields of wild artichokes extend near Abiar, Barka and Derna. Apart from poor fields, the stony limestone slabs of Benghazi are thinly covered by red karst soils supporting low scrub as far as the start of the coastal dunes. Only in dolines, where terra rossa has been deposited, do date palms as well as figs, olives and almond trees grow. Likewise the oases at the coast are small. To the east of Tokra the strip of coastal steppe narrows and widens again only east of Derna where, in the northern sector of the Jebel, a typical steppe flora occurs — including inter alia some Umbellifers of African character — which was lacking in parts of Tripolitania.

b) Evergreen Hard-leaved Bush

In both the Libyan mountain ranges near the sea, the Tripolitanian Jebel in the west and particularly the Jebel Akhdar in Cyrenaica, evergreen hard-leaved bush has been preserved as a remnant of former forest stands. In Tripolitania it is found over reddish-brown, damper soils which are largely occupied by plantations of trees. Nevertheless, the wild olive tree, the carobs, figs, junipers, the mastix shrub (Pistacia lentiscus), myrtel and pines are retained in loose, island-like stands. Attempts are being made to afforest larger stands by planting

Quercus ilex, acacias and eucalyptus. Apart from some oases with cultivation, the western Jebel away from the sea supports steppe which becomes sparser towards the south and finally changes to dwarf-shrub steppe. The vegetation of scarcely one foot-high thorn bushes, shrub thickets and cushion plants continues to thin out progressively. Finally the stone desert dominates; bushes and isolated trees like acacias and tamarisks, withdraw entirely to the wadis where they form a strip of thick vegetation.

On the Jebel Akhdar the heights to a distance of up to 50 to 60 km. from the coast are still covered by dense, evergreen maquis in parts. Already on the first scarp between 100 and 250 m. above sea-level, the bush begins between Tokra and Bomba but is frequently interrupted by extensive fields. On the second scarp (400—500 m.) it becomes denser, forming proper bush forests with straight trees about 10 to 12 m. high and consisting in the main of junipers (Juniperus phoeniceus) but additionally of Lentiscus (Pistacia lent. = Batum) which reaches heights of 6 to 8 m. They are joined by Quercus ilex, myrtel strawberry trees (Arbutus unedo), tree heather (Erica arborea), Ricinus communis and others. The wild olive is very widely spread and is thought to be a descendant of the olive plantations of ancient times and numbers two million between Barce and Derna Cypresses (Cupressus sempervirens), once widely spread and already mentioned in ancient times, have unfortunately been extinguished during the last war save for a few specimens in the el Caf wadi. Those which were 20 to 30 m. high seem to have all been destroyed. Only sixty years ago they are said to have formed forests. Towards the south the islands of bush forest become more frequently interrupted by steppe consisting of thyme, rosemary, gorse and cistrosea which changes to sparser thorn-bush steppe consisting of Zyziphus, Rhus oxyacantha, tamarisks and cushion plants as well as various herbs towards the pre-desert area. Here grew silphion, (Drias, Thapsia garganica?) the ancient medicinal plant which is said now to be extinct.

c) Desert Vegetation

Towards the desert the flora gradually becomes poorer. Species and individual plants themselves decrease as a result of regression and irregular distribution of rains, increasing temperatures and higher evaporation. The north African flora becomes predominant. These plants are able to survive thanks to their longer roots, reduced leaves and encased seeds. Already by the northern part of the desert the vegetation has entirely withdrawn towards and into the sandy and stony beds of the wadis which are picked out by isolated acacias, Retama thickets, Rhus oxyacantha, Zilla spinosa, coloquints (Citrulla colocynthis) and grasses, amongst them Had (Cornacula monocantha) which is well-liked by camels. When the soil contains more salt, few Salsolacaea and composites are found. Outside the wadi floors isolated acacia bushes, Retama and Atriplex shrubs stand on the lower parts of the gravel-strewn slopes. The stony areas and gravel plains between the wadis are practically without vegetation, but here too as on the Hamada el Hamra, a short-lived herb flora sprouts after rains on the reddish mantle rock between the rock and shallow rain pans. In the low hill lands the vegetation moves upwards in the wadi beds and plant growth, which often becomes somewhat lusher in small basins, can be traced up to the heights which are thus worth visiting as far as the nomads are concerned.

In Fezzan, apart from the almost barren serirs (gravel deserts), stone and sand deserts occur on elongated, valley-like flats like the Wadi es Shati, Adjal and others, in which groundwater comes close to the surface, creating swamps and sebkh and providing the conditions for better, more lush vegetation. Here man has created extensive date palm oases which continue across some 100 km., interrupted only by strips of wild-growing palms and bush vegetation. In the oases there grow some acacias, tamarisks and Calotropis procera which migrated from the south; on their fringes there are shrubs of Traganum, Zygophyllum as well as "Agul" (Alhagi maurorum), Graminaea and woody Chenopodiacaea. A sparse wood of acacia and tamarisks extends west of Ubari in the Irauen wadi; the distance between the trees of these groupings amounts to 10 to 20 m. and that between the groups to some 100 m. Swampy places in the valley-like depressions are surrounded by Juncus arabicus; on semi-swampy land Euphorbia granulata grows and in places, where the water forms small lakes on the surface near Traghen, apart from Juncus arabicus the water is surrounded by Imperata cylindrica, Scirpus litoralis and others. Phragmites comm. grows beside as well as in these waters, in which algae can be found. In the Berdjudj wadi there are rich pastures with tamarisks, zilla and had, or with Zygophyllum album and Alhagi maurorum in the Hofra. Even the sand and dune areas of the ergs are not entirely without vegetation. From the hatiets which surround the oases, extensive tongues of vegetation make their way into the Ramla. They consist predominantly of tassel grass of Aristida pungens with their over 20 m.-long roots, of woody Salsolacaea such as Antiplex Halimus and Traganum nudatum which line the foot of the dunes.

Outside the few oases vegetation continues to grow poorer towards the *extreme deserts* in the east; vast plains appear completely without vegetation. Only the wadis in the northern spur of the Tibesti support some grass, shrub and tree flora which increases progressively southward and permits steppe-like strips of bush with trees to grow in the wadis which terminate towards the plains. The Arkenu-Auenat inselberge near the eastern border of Libya present only insignificant vegetation in their wadis; only after rare rains are they surrounded by a lush growth of herbs and grass for a short period. Thus even the most desolate deserts are not quite devoid of all plant life. They simply grow extremely rarely and sporadically. Their sprouting after rains shows that there are spores nearly everywhere in the dusty soils and that they can survive through lengthy dry periods.

6. The Animals

As far as zoogeography is concerned, the animal kingdom of north Africa — and thus also of Libya — is readily placed in the Mediterranean sub-region within the palaeoarctic region, which latter presents a kind of transitional zone to the African animal kingdom and thus to the Ethiopian region. In Africa it includes the entire area north of the Sahara. Among the *mammals* there are, of course, African forms represented like civet cats, Hyracidae and various small mammals (as for example Soricidae) besides palaeoarctic elements. Lion,

elephant and ostrich, whose eggshells can be found practically everywhere in Libya, are extinct at the present time. Due to its separation for a time, Cyrenaica is populated by some animals which do not occur in Tripolitania. On the whole in both parts of the country as far as the desert the fauna is neither rich in the numbers of species nor in individual animals.

a) Wild Animals

In the steppe and desert gazelles are to be seen and far to the south there are still possibly Addax and Oryx antelopes where they have not been made extinct in recent years. Finally there are the Waddan (maned sheep) which occur outside settled areas as far as Tibesti. In the wider vicinity of the oases and also in the bush-steppes of Cyrenaica, laughing hyenas can be heard at night and jackels and fennek (desert fox) prowl around the camp site; a black and white marten-like skunk (Zorilla), dogs which have gone wild, foxes and wild cats (Cyrenaica and Tibesti) rove around. Porcupines and hedgehogs live on the plateaus of the Jebel Akhdar and the Tripolitanian Jebel together with a great number of various kinds of mice, amongst which jumping rats attract most attention. It is seldom that one of the bigger mammals is to be seen and only at night do they leave their hiding places. One wonders, however, how the innumerable smaller mammals, especially the mice and gerbils, can possibly scrape an existence in the open desert. Once one of their kind turns up and finds food there will be ten and twenty there soon after. Although they are fond of green or dried-up bushes in their immediate surroundings, they can also be encountered in the areas of fine, silvery Aristida grasses and even in areas without vegetation. Roots, pollen and blown seeds appear to remain in the ground for long periods as is indicated by the presence of numerous cockroaches and mantides which in turn provide prey for the mice.

Much more noticeable in the steppe and desert are the *birds* which increase their numbers in the north of Libya during the winter and in the desert during the period of migration of birds of passage. Amongst the stationary birds, sky larks, sparrows, partridges and other flying fowls as well as pigeons, owls and vultures, are predominant; the former chiefly brood amidst stones and bushes in the northern highland. They are joined by masses of birds of passage; swarms of quail and turtle doves and many other Eurasian breeding birds. Every evening during the winter months swarms of starlings descend upon the trees of the streets and squares of Benghazi; grallatores, blue breasts, bee-eaters, thrushes, blackbirds, finches and tits are distributed over steppe and oases besides hoopoes, yellow thrushes and various kinds of swallows. From here they move to uninhabited, waterless wadis and even outside the time of their migration they can be met miles inside the boundaries of the lifeless desert. During the migration time the desert appears to be populated by birds. Particularly when they are impeded by a keen north-easterly wind do they shelter behind stones, rising only to make way for man although they do fly in small groups against the wind too. The Lanner falcon, their enemy, who broods amidst the rocks, lurks in the desert and catches prolific prey before it returns to the north. Water-birds populate the few water-bearing wadis in the north and isolated lakes in the desert. There are ducks, geese, waterfowls (Wau en Namus); herons and storks seem generally to fly quickly across the desert. Larger numbers of flamingoes were not encountered except in the shallow lagoons near Benghazi.

Apart from the steppe, *reptiles* are chiefly found on the fringes of oases and wadis where numerous large and small species of lizards, agamids, warans and tortoises can be observed. The chameleon lives particularly in the north (Tripoli — Azizia) and in the Fezzan on trees and bushes; geckos which inhabit houses, are valued as insect eaters. Most of the snakes which occur are vipers: the horned viper, Cerastes cerastes, Bitis lachesis (puff adder), the Naja haie, the Egyptian cobra which hunts mice both in the steppe and on the desert fringe of the wadis (Fezzan). The adder (Psammophis biseratis) occurs near Ghat, but my Arab companion killed one specimen 1½ m. long at the Tmed Aleua (north of the Wau en Namus) and JANY mentions it from the area around Kufra.

In the steppe and desert alike the numbers of *insects* and other arthropods are extraordinarily high. Above all ground and sand beetles, carrion beetles, dung beetles and scarabees are noticeable here. Ants, termites, wild bees and wasps, mosquitoes (among them Anopheles), flies, horseflies, crickets and locusts which often cause a lot of damage in the steppe by virtue of their mere numbers, even some poisonous kinds of millepedes, spiders, cockroaches, and woodlice can be traced far into the oases of the south. Bedbugs live in houses and huts and great numbers of ticks under palm bushes and thickets. Different species of scorpions, which occur everywhere, often build up to such a degree that homes in the oases are abandoned by their inhabitants because these creatures actually fall from the palm frond-covered roofs. Neuroptera and dragonflies live in the vicinity of wells and springs. Butterflies are rare but moths are more numerous. Great numbers of them collide with lamps and woodfires. The indigenes harbour true lice: head lice, cloth lice and felt lice. Their numbers have been greatly reduced since they have been combatted by insecticides. There are few human fleas in the Sahara.

As mentioned, there are only a few places in Libya with stagnant water. At such places and still more frequently, however, in the periodically-standing water of the gueltas as well as in swamps and wells, there are toad-like amphibiae and particularly the Bufo viridis which is met in almost every oasis from Tripoli to Gat.

Apart from the larvae of mosquitoes, the water is populated by water fleas and water ticks. In various salt-lakes in the Fezzan the Artemia salina occurs as well as ringworm and cercaries of annelides, leeches and snails (Limnaea). In the Fezzan molluscs flourish in wells, in swamps and under rocks — Bulinus contortus the most important temporary host of Schistosoma haematobium, Melania tuberculata and Limnaea ovata.

Although there is water on only a few days during the year in the wadis between Ghat and Gadames (western Tarat, western Iseien), small fish can be observed there, surviving the dry periods in the mud (Clarias Lacera Siluridae), Barbus deserti and Hemichromis bimaculatus and they are also to be found in Tibesti. They also occur in some wells of the Ghat oases. The Gambusia Holbrooki was introduced to the lakes at Murzuq and Traghen to exterminate the mosquito larvae.

b) Domestic Animals

Of all the domestic animals kept by the Libyan natives, the dromedary (single-humped camel) occupies

the first place. Together with the palm tree it is the first thing to strike the visitor as being unusual. Two types are distinguished: the heavy, coarse-boned, load-carrying dromedary which is now bred increasingly for slaughter purposes as well and the slim, long-legged riding animal, called the Mehari, which is bred for its speed in steppe and desert. Besides the transport-camel used to transport goods over longer distances, donkeys of smaller or larger growth are employed for shorter stretches. The donkey is extremely modest in its appetite and, if kept well, is a fine animal with a smooth skin and dark stripe across its back. There are two races of horses in Libya: the heavy ram's head Berber horse (belonging to the Iberian horse forms) which, as evidenced by rock painting, was already in existence in Libya in early times. The oriental type of horse only arrived in the country about 1,500 years ago.

Cattle are also typically Libyan. They are small, black-brown to fallow, short-horned animals. Since they give little milk, cross-breeding with European cattle has been attempted but the latter are more prone to diseases. Occasionally European cattle are kept as dairy cattle in stalls in the towns. Small cattle, i.e. sheep and goats, are the most important animals of the nomads and semi-nomads: larger herds of them can be seen grazing in the steppe and far into the wadis of the desert. Here too, the fat-tailed sheep, the male of which is decorated with its well-known elongated spiral horns. The colour of their wool ranges from black to white. In the Fezzan and Kufra further to the south, long-legged sheep, a typical steppe breed, are kept in addition to the fat-tailed sort; these have thick, straight hair instead of wool and the ram carries a mane. The horns grow as spirals standing well out from the head. At times both these breeds are joined by maned-sheep of small stature which are thought to have come here with the Hamites together with the long-legged sheep. The goats are fine animals with long, lustrous hair of a black or white colour or a mixture of them. The large horns of the rams are twisted in spirals, those of the nannies are slightly crescent-shaped. They represent an old and typically African form. Because of their higher milk production, Maltese goats have been imported in certain areas, as for instance Tripolitania.

Dogs show a multitude of cross breedings. Three races can be distinguished: a small, black and white or brown-speckled African dog with stiff ears which occupies itself as a rubbish-clearer in the settlements; then the large, fine, chiefly white, Berber dog — a good guardian for tents and herds; finally the Slughi, a highly-bred hunting greyhound which is carefully looked after while the others are treated with kicks and the throwing of stones. Cats occur in a variety of mixtures as well: in the Jebel a tawny cat with a light tawny fur and a pink nose is found. Chickens and pigeons live near the houses of settlements, the pigeons in cracks and gaps in the walls or in simple wooden boxes hung up for them.

The census of domestic animals in Libya (1960) showed the following:

Sheep	860,000	Cattle	80,000
Goats	950,000	Donkeys	92,000
Camels	153,000	Chickens	782,000

B. Man and His Ways of Life

1. Historical Review

a) The Prehistoric Time

Research carried out into the recent geological past of Libya has shown that already prior to the Quaternary, longer *dry periods alternated with rainy periods* and that in diluvial times both of them changed in a particular rhythm according to the advance or retreat of the ice in Europe. Under warm conditions, as was the case for example during the last interglacial period, no migrating depression zones reached the North African coast as they now do during the months of winter; the north-east winds which blew in summer were also weakened so that the monsoon which brought humidity from the equatorial zone blew far beyond the central mountains of the Sahara towards the north. There was considerably more rain in the Sahara then than now with desert conditions appearing only towards the northern fringe.

Then came the last *Ice Age* (Würm glaciation), during which it became cool in North Africa. Wandering depressions, shedding rain, penetrated deep into North Africa. The desert retreated to the south as far as the Sahel and was probably much reduced in width. During the post-glacial period warmer temperatures gradually restored the monsoon as well, thus bringing about greater humidity in the southern Sahara and gradual increase in aridity in the north where the dry trade wind (north-easterly) advances far into the country during the summer months whereas wandering depressions generally only reach the northern fringe. Since then it seems that small climatic fluctuations over the course of centuries must be taken into account, similar to the European situation. At the time of the Romans and again in the 15th and 16th centuries, the Sahara was somewhat more humid so that herds of cattle were able to advance towards the north.

Archeological discoveries confirm the climatic changes cited above. Primitive cultures of the lower Palaeolithic (Old Stone Age) can already be established as dating from the last inter-glacial period. North Africa appears to have been inhabited by light-skinned, fair-haired peoples who are seen in connection with the Cro Magnon race. They were joined by dark-haired, short-heads related to the pre-Aryan southern Europeans whose original hearths are to be sought in Europe or Asia and in any case near the Mediterranean. Both of them are not, in the strict sense, African races.

In the post-glacial period increasing humidity in the southern Sahara allowed dark-skinned agricultural peoples from the south to advance while light-skinned Libyans (Gatulians) populated the Sahara as cattle-herders. This was the time of the Neolithic, the New Stone Age (about 3,500 to 1,500 B.C.) from which

numerous rock-drawings and cave-paintings have been preserved. Not only do they depict cattle, often with long-curved horns, but also hunting scenes together with animals such as elephant, rhinoceros, giraffe, crocodile, ostrich and others, which are now extinct in the Sahara. At the time of the Romans there were still elephants which populated the forests at the southern foot of the Atlas; lions (black-haired Berber lions were still near Bone in 1892) were made extinct here only about a hundred years ago. Only a few decades back herds of giraffe enjoyed themselves in the Sahel and in some of the Ennedi lakes of the central Sahara stunted crocodiles have been found. The last of the ostriches seem to have disappeared at the beginning of this century. Whole nests of ostrich eggshells can be found in the wadis west of the Haruj for instance and shell remnants in the serirs. The father of my guide Belgassem kept a tame ostrich in Tobga after 1900. In addition to the impoverishment of the fauna in Libyan North Africa, a decrease and impoverishment of the flora as well as a gradual drying-up of the groundwater is to be observed at the present time.

b) The Early Historic Time, the Garamantes Period

Thus during the *Neolithic* the Sahara could still be crossed fairly easily. A mixing of the light-skinned people in the north and the reddish-brown cattle nomads occurred and produced the present Libyans. They had close connections with the Egyptians whom they did not paint red as the Egyptians themselves used to but light with fair and brown hair. Herodotus (5th century B.C.) still described the Libyans as light-skinned, slim and strongly built. There were contrasts between the nomads and agriculturalists but they did not seem to play too big a role in Libya.

In the following period two animals became important for the Saharan peoples: the horse and the camel. In the course of the Semitic migrations, Semitic peoples under Sesostris (12th Dynasty, about 1,890 B.C.) advanced towards Egypt. They are supposed to have already been in possession of camels for Abraham, who probably visited Egypt at about the time of the Hyksos (1650—1550 B.C., 15th Dynasty), brought camels with him (Genesis 12, 16) while the Hyksos advanced from Asia with horses and carts. In those times trade using camel caravans was brisk in the Near East and towards the Nile Valley (Genesis 32, 8 & 16; Ismaelite caravans: Genesis 37, 25). A pestilence among the cattle is mentioned in the book of Exodus 9, 3.

The Egyptians and later the so-called maritime peoples apparently introduced the horse and cart to the Libyans. At that time (about 1200 B.C.), Achaeans, Sardinians, Sikulians, Thyrrenians and Philistines started out together with the Libyans towards the western delta of the Nile. They were beaten by Ramses III (20th Dynasty, 1171—1085 B.C.) and some of them settled in the delta. Libyans appear to have pushed on in the following period because Sheshonk I (22nd Dynasty) (the Shishak of the Bible, 1 Kings 14, 25; about 950 B.C.) was a Libyan.

Already by about the middle of the second millenium a desert empire developed in the Sahara, the centre of which with it capital Garama, was in the present Fezzan. Here the Garamantes who, according to Italian excavations (Pace, Caputo) were of a type very similar to the present Tuareg. They are more closely affiliated to the Indo-Germanic peoples than to the Semitic ones. A feeling of propinquity linked them with other Libyan tribes around.

The Garamantes had already adopted horses and carts either from Egypt or from the Phoenician Punici in the north. Equipped with their light battle-wagons with two pairs of horses (Herodotus IV), they threw back the Ethiopians in the south and also advanced northward across the Hamada. Rock paintings of the latter half of the second millenium show helmeted warriors, armed with javelins and four-wheeled battle-wagons and also with carts drawn by oxen. Their culture received strong influences from the coast as well as from southern Morocco from whence they got the Tifinag, the Libyan letters of Phoenician origin.

Between Egypt, the maritime peoples in the west (Senegal, Morocco), the Mediterranean coast and the Sudan, transport roads had developed on the basis of trade relations. The route to the west connected Thebes with Siwa (where a Libyan dialect is still spoken today) and Augila in the country of the Nasamones, from whence Garama could be reached in ten days. Beyond the Ahaggar the Niger was reached in the south and the salt mines of the Taudeni in the west. From the coast of the Sirte a route led over Cidamus (Gadames), the Tassili to the Ahaggar and further to the Niger, another more westerly one from Numidia across the Gatuli area (west of the great ergs) and Pharusii to the upper Senegal.

West of the Nasamones (Augila) in the Sirte region, the Makens and Gindams — further Libyan herding peoples — moving nomadically with their flocks of sheep. These are the tribes called Tehenu by the Egyptians in Cyrenaica.

c) The Settlement of Foreign People on the Libyan Coast

Towards the end of the second millenium (about 1200 B. C.) the *Phoenicians* began to intrude into the western Mediterranean, probably in the course of the migrations of the maritime peoples. At first they settled on the coast in trading factories, probably in places of Libyan settlement which had already established connections with the hinterland. Only later did fortification of the settlements take place. Thus from the wealthy city of Tyros, which was suffering from constant pressure by the Assyrians, Carthage was established in 814. The settlements along the Tripolitanian coast had been established some time previously, particularly Sabratha at the end of the route to the Niger where, in the 5th century, the Carthaginians had walled-in their factories. The second town to be established was Leptis (at the close of the 5th century) situated at the mouth of the Lebda wadi; at first it was only a modest outpost of the Carthaginians and only acted as the starting-point for the route to the Fezzan. Little is known about the foundation of Oea. As at Carthage there would have been increased settlement of Libyan farmers in the vicinity of towns with cultivation of date-palms, some grain, olives and wine — the latter items having been introduced by the Phoenicians. Stock breeding by nomads provided both cattle and horses as well as the wool and hair of sheep and goats.

With the start of the 5th century B. C. the great Sahara expeditions of the *Punici* also began and were aimed at eliminating the intermediary trade of the Gara-

mantes. They employed oxen, horses and carts and as pack animals probably donkeys. Since the Punici, who originated in Asia, appreciated the endurance of the camel they are likely to have introduced it in greater numbers after their first crossings of the Sahara. Camels from the western part of North Africa are, however, mentioned for the first time in the 1st century B. C. Caesar gained 22 camels as booty from King Juba after the Battle of Thapsus in April, 46 (MOMMSEN, Röm. Geschichte vol. V).

The Carthaginians received gold, ivory, ostrich feathers, skins, emeralds and chalcedony from the Sudan. At the beginning of the second century the customs' revenue of Leptis alone added up to one talent daily for the Punic treasury (according to Livy, XXXIV, 62/3). The date-palm was probably spread by the Punici from the coast as far as the country of the Garamantes.

After the destruction of Carthage in 146 B. C., the inhabitants of Tripoli took up the old connections with the south once more. The Romans left them the Numidian Empire of King Massinissa at first but the cities voluntarily attached themselves to the trade politics of Rome. Thus after the war against Jugurtha (106 B. C.) they joined the Roman province of Africa without suffering any losses.

In Cyrenaica settlement and cultural development took a different course from that of Tripolitania. In the year 640 B. C., Greeks from Thera, followed by Spartans and Cretans, went ashore on the island of Platea in the Gulf of Bomba. Under the leadership of a Spartan, Battos, the town of Cyrene was founded from here in 630 B. C. on the strength of the Delphic oracle and was soon populated by Greeks from the Peloponnese and the islands. This occupation led to a struggle with the Libyans and in 544 the Greeks suffered a heavy defeat. Consequently the royal power of Battos' successors was limited by a democracy but was able to hold out until 450 B. C. Prior to this the founding of further towns had begun from Kyrene: Barka (Barce) in 567 B. C., Euhesperides (Berenice, Benghazi) in 515 B. C., then Teucheira (Tokra) and Apollonia (Marsa Susa), the port of Kyrene (= Pentapolis). Cyrenaica became extraordinarily important for Greece as a supplier of grain; moreover, it exported sylphion (Thapsia Garganica var. Sylphium = the drias of the Arabs) a medicament for use against heart diseases, as well as ceramics, vases and the sweet-scented resin of a kind of cistus. The nomads supplied the products of sheep and horse breeding. Even with Carthage the Pentapolis took up trade relations. After a short struggle for the limits of the spheres of influence, an agreement was reached soon after 450. Charax become the entrepôt for goods; it is not far from the modern oil-port el Sider. The five cities of the Pentapolis grew, luxury spread, arts and science flourished and in Kyrene a school of philosophy was established.

Cyrenaica surrendered to Alexander the Great (332 B. C.) without any bloodshed and after heavy fighting a few years later it had to recognize the sovereignty of the Ptolemy Ptolemeus Soter I. Ptolemais (Tolmeta) was founded as the port of Barka. The importance of the towns decreased under Egyptian rule; increasing intermarriage with foreign national elements occured; Hellenism receded. Apart from Libyans and Egyptians many Jews settled in the towns and at times amounted to one quarter of the urban population.

d) Libya as a Roman Colony

In the year 95 B. C. hereditary succession caused the country to pass to the *Romans*. As riots broke out in the tributary country, Pompey subjugated it in 67 B. C. and together with Crete, combined it into a single province. Only at the time of Trajan did it come back into the news when in 116 A. D. an uprising of the Jews occurred in the course of which 200,000 Greeks and Romans were annihilated. It was bloodily repressed. The Romans attempted to lift up the depopulated country again by founding the colony of Adrianopolis, but nomads had already taken possession of large tracts of fertile land which could not be regained from them. So the country, rooted in misery, became a province of Byzantium and suffered under the occupation by the Sasanian Persians (Chosrav II at the time of the Emperor Herakleios 610 to 641) until the final invasion of Arabs in 642 A. D. finally extinguished everything that was Greek.

After its addition to the province of Africa, Tripolitania was at first spared war-like experiences. The civil wars in Italy being ended, the settlement of veteran legionaries and Libyan farmers gradually pushed the limit of cultivated land further to the south with the result that riots among the nomads broke out as they saw themselves displaced from the best agricultural lands. They in turn were supported by the Garamantes and so Cornelius Balbus made an attack on the Fezzan between 20 and 19 B. C. Cydamus (Gadames) was occupied and from here across the southern Hamada Garama was taken. The Legio III took over the frontier guard. The Garamantes advanced twice more to the north: once to Numidia in order to support the liberation war of Tacfarina (17 to 24 A. D.) and a second time, when summoned by the town of Oea, which could not compete with its rival Leptis any longer.

The Pro-Consul Valerius Festus repelled the Garamantes, pursuing them as far as the Fezzan. Later the Garamantes joined forces with the Romans at the time of both their attacks on the country of the Ethiopians as far as Agysimba (probably in the Sudan between the Niger and Chad) at the close of the first century under Septimus Flaccus and Julius Maternus.

As for Tripolitania a long period of peace lay ahead. The southern border towards the nomads was protected by a series of forts. To the fortification of Cydamus those of Gheriat el Garbia and Gheriat es Shergia were added. Between Misda and this advance position about every 30-km. from one another remnants of fortified towers with walled-in courts, probably intended for the protection of caravans at night, can be seen on the "intra montes" road beyond Brak and Garama. Probably es Shueref as the last well before the narrow pass through the western branches of the Black Mountains (Jebel es Sauda), has been fortified. Bu Ngem was a strongpoint for about a cohort on the "extra montes" caravan route from Leptis via Socna to the Fezzan. The forts were connected with one another by a kind of "Rennweg".

Possibly Garama in the foreland was still fortified, as the tomb of Caecilia Plautilla, a portal and mosaics are here in the ruins of the location. Larocu at the passage across the Bab el Macnusa on the road via Janet to the Niger was probably fortified, as well as Zuila (Cillaba), which covered the caravan route to Bornu in the eastern Hofra.

Behind the military border towards the nomads, settlement of Libyan and Roman farmers and colons adjoining the coastal strip occurred, where, founded on the cultivation of olives and wine, large estates developed in some places — for instance around Zliten (mosaics), Misurata and in the catchment area of the Caam wadi (Kinyps) and Lebda. Also densely settled were the Jebel and the large wadis: Soffedjin, Zemzem and Bei el Kebir, where remnants of village lay-outs — especially on low inselberge — and isolated farms in sheltered positions are to be found. Everywhere in the wadis numerous but largely derelict cisterns are encountered as well as dams for the regulation of water in the wadis, remains of irrigation and terrace construction, oil mills, derelict fortified towers, milestones on the roads and isolated mausoleums.

The three coastal towns flourished thanks to the carrying-trade across the Sahara — i. e. the import of Sudanese products (see above) and the export of wine, textiles and glass-ware thence. Textile workers were occupied in the textile industry, potters produced crockery, black smiths and goldsmiths were at work. At first the oil produced in the country was of poor quality and was used in Rome for the manufacture of soap and for illumination purposes. Thus the town dwellers soon came to own latifundia, houses and hundreds of slaves. Some hundred families were counted as millionaires.

Leptis Magna developed gradually as a deep-sea port and with the aid of the Emperor Septimus Severus who decorated his birthplace with buildings (triumphal arch: 203) and sponsored it in every way, it became the second largest town of the province inhabitated by 80—100,000 people. Sabratha as a transfer point for the trade with Sudan, numbered 15—20,000 inhabitants and had a great number of multi-storey houses as were usually only seen in coastal towns. Oea, although smaller, contained the four-span Triumphal Arch (163 A. D.) of Marcus Aureleus (161—180) and his adopted brother L. Verus within its walls.

In spite of the contact with the cultures of Egypt and Greece, the Roman one was actively promoted. Romanisation extended far into the Sahara. In Tripolitania a form of lingua franca was spoken: Numidian strongly mixed with Libyan and Punic elements as well as Latin technical terms. Language and script, the Tifinag, spread in the Sahara. Christianity arrived in Africa from Rome (in about 180 A. D.) and was soon preached everywhere.

In the southern hinterland of the towns there were soon 500,000 people living, a number the country could scarcely support. The excess of births tended to be in the towns which grew excessively through the property-less proletariat. Taxes rose and general wealth decreased. In the year 251 an epidemic, possibly the plague, broke out and for a second time soon after in Italy and Africa in 260 where it raged especially strongly. This was under the reign of the Emperor Valerianus (253—260) who conducted unsuccessful wars against the Germanics and Persians. When he was captured by the Persians and died the entire empire fell into a state of turmoil; Africa, however, remained comparatively unaffected. Diocletian (284—305) succeeded once again in delaying the dissolution of the empire and carrying out the reorganisation of the administration. In the border districts of Tripolitania (now the province of Numidia tripolitania) conflicts with advancing nomads began to occur in various places soon afterwards.

For a final time Theodosius united the collapsing empire (394). Riots and struggles, partly of religious, partly of social character, broke out everywhere in Africa as well. When Alarich took Rome in 410, export from the towns stopped, unemployment and cuts in salaries followed and agricultural workers in particular, together with the slaves, incited uprisings. The Empire fought for its existence; above all it had to keep the advancing people from the north away from the ports of the Mediterranean. Thus a law passed in 419 provided for the death penalty for those who taught foreign people navigation and shipbuilding.

Nevertheless, the Vandal fleet was built with the friendly co-operation of Iberian mariners on the coast of northern Spain from which they crossed over to Afrika in 429. Apart from Carthage, Numidia and the province of Africa were in the hands of Geiserichs in 431. Only eight years later the city was taken by surprise. The small number of 80,000 *Vandals* and Alans did not permit the occupation of the Tripolitanian towns; diseases (malaria and others) decimated the troops and the people. They were only able to destroy the fortifications of the towns. Well known is the conquest of Sicily, Sardinia and Rome (455) with the aid of the Libyans and Punici, but the fights with the nomads who were advancing gradually from the south, were not successful. Geiserich had, until his death, managed to keep luxury and moral corruption away from his people. When, at the age of 80, the King of the Vandals and Alans, died in 477, the influence of the Alans too disappeared at the court of Constantinople; they had prevented any action against Geiserich up to that time but then Belisar, the East Roman general, landed in Africa and defeated Gelimer, the great-grandson of Geiserich, on several occasions (533). The remainder of the Vandals were destroyed in fruitless uprisings. Africa, Tripolitania, and Cyrenaica were amalgamated into a single province, the limes were restored.

The entire country was in a sad state when Berber camel-riding nomads devastated it. Some coastal towns were fortified once again but the power to drive back the Libyans was lacking. The Cyrenaica suffered from ten years of Persian occupation. During this time of general decline Oea took the place of Leptis as the naval base and was renamed Tripoli.

e) The Conquest of Libya by the Arabs

In the year 642 the *Arabs*, advancing from Egypt, conquered Cyrenaica and, a year later, due to the weak resistance of the Byzantines, Tripolitania and Tunis as well. Tripoli was stormed, Sabrata and Leptis plundered. Only the Libyan Berber tribes displayed determined resistance here as well as in Cyrenaica where the Byzantines were also trying to reassert themselves. The Arabs, who under the Aglabites had created a centre in Kairouan (about 800), had to retreat to Cyrenaica. Only another attack under the Fatemides united the parts with the west once more. Peace reigned for a while under the viceroys of the Fatimides; then fights with the native Berbers began everywhere, even in Tripolitania, until, after the conquest of Egypt (968), the Fatimides installed the Beni Hillal and Beni Suleiman (Sliman) against the rebellious Maghreb in 1050 who released a wild religious

war. The Beni Hillal immediately pushed through to the west, whereas the Beni Suleiman stayed at first for some time in Cyrenaica and then moved slowly on to the Fezzan (12th century) and finally to the Sudan; only parts of both tribes remained in the Sirte and Tripolitania. Barka, surrounded by walls and ditches, an important place thanks to its connection with the coast at Tolmeta and with the interior, remained in Egyptian hands.

The last remnants of Christianity and Roman culture were broken, the plantations destroyed, agriculture abandoned, the towns annihilated or at least depopulated. Only the port of Tripoli retained a certain value. In the year 1183 an earthquake destroyed the town; 20,000 people are said to have died. Tripolitania was put under the government in Kairouan. Islamization and the fusion between Arabs and Berbers proceeded fast since both peoples harmonized in many aspects of their cultures and customs. The Arabs were fond of marrying the beautiful daughters of the Berbers. The arabization effected an ethnic change; today the Arabo-Berbers are the strongest element of the Libyan population.

This did not, however, restore peace to the country. Adventurers and princes sought to establish a reign. It appears that during this time of the Crusades, leprosy was brought back to North Africa. The Normans chased the Arabs away from Sicily, occupied the island of Jerba and conquered Tripoli from there for a period of 15 years (mid-12th century). The Hafisides established themselves in Kairouan, united Tunis with Tripolitania into Ifrikija and, in 1318, transferred their residence to Tripoli. Shortly after they lost the town and its environs to the Beni Thabit and in the year 1355, temporarily to Filippo Doria. At this time (1348), the lung and bubonic plague, the "Black Death", was introduced by way of Italy. In the second half of the 15th century, Tripoli under the rule of the upper class was proclaimed a free-town and like other states it began to accumulate wealth from piracy on the high seas and from the black and white slave trade. In order to suppress such a situation, the Emperor Charles V of Spain occupied the towns of North African coast from Spain. Tripoli as well as Malta he entrusted to the Order of the Knights of St. John, fortified it and built the fortress until 1551 when Chaireddin Barbarossa conquered the city and placed it under the sovereignty of the *Turks* who had already taken over Cyrenaica in 1517.

f) Libya as a Turkish Tributary State

At first the Turkish tributary state was governed by pashas appointed by the Sultan's Palace; most of them were not particularly vigorous. They were scarcely able to assert themselves against the Janitjaren who continued to rebel since the government in Constantinople usually acquiesced when they themselves installed their Deys. Sea robberies resulted in conflicts with European states with the result that Tripoli was frequently bombarded by them from 1654 onwards. Uprisings fomented in the interior. Nevertheless, Tripoli was still able to make the Fezzan subject in 1576—77; the Fezzan had fallen with the display of little resistance into the hands of the Arabs, who had destroyed Garama, in 662. From 900 until 1100, Cillaba-Zuila had been the capital. This was conquered by Sudanese from Kanem; Traghen became the capital until, in 1300, a Moroccan tribe overran the country, founded Murzuq (1310) and made it the capital. It remained a sultanate for a period of five centuries.

During the years 1683/93, Tripoli was fired on by the French on several occasions. The government had to yield to the pressure until Ahmed Karamanli, an energetic and able Turkish cavalry officer, deposed the Dey and Pasha and took over the government himself. Ahmed III, the Turkish Sultan, finally recognized his hereditary dynasty. Once again he annexed the lost Fezzan, sent his son as governor to Cyrenaica and attempted to put political and economic relations in order. As retaliation against piracy Tripoli was once again bombarded by the French in 1728.

During the ensuing years weak rulers alternated with vigorous ones. Rebellions and civil war occurred in the hinterland and in addition to these, the year of 1785/86 brought a severe famine accompanied by the plague. More than a quarter of the 14,000 inhabitants of Tripoli perished. Just as the former pashas had been, so the Karamanlis were dependent on payments made by European states to safeguard their trade and sea-going subjects. The Americans refused to pay tribute. When some of their ships were captured they fired on the town and carried out an expedition against Derna, which was temporarily occupied in 1805. In 1816 the plague broke out and only 500 persons of the 7,000 survived.

Constant agitation by the Berber states was also a subject of discussion at the Congress of Vienna. On several occasions the French and English had sent fleets to the coasts and smaller states had also sought to rid themselves of the tributes. Continuous skirmishes, revolts in the Fezzan and Cyrenaica, the lack of finance and the dissatisfaction of the Janitjaren led finally to the overthrow of the Karamanli (1835) and the Turkish Sultan decided to re-occupy Tripolitania himself in order to prevent it falling into the hands of the European powers. Till 1842, the Turks ruled once more in the country save for the Tripolitanian Jebel which persisted in revolt until 1858. Cyrenaica had effectively come under the rule of the Senoussi. This order which had been founded in 1835, started its missionary activities from Sauia el Beida on the Jebel Akhdar with the aim of reforming Islam. It covered the country with a network of bases. Its influence grew particularly strongly as an outcome of the transfer of its headquarters to Jaghbub in 1856, a place outside the Turkish sphere of power. The order appeared hostile to foreigners, stopping Europeans from travelling and involving itself in conflicts with the French in the south of the country. In 1895 the headquarters were transferred to Et Tag in the Kufra oasis.

g) Libya as an Italian Colony

At the time of the Franco-German conflict over Morocco the *Italians*, in the hope of securing the help of the population and the Senoussi, occupied Tripolitania in the year 1911. However, an Islamic combat group was formed to combat the Christian enemy, and after the outbreak of war in 1914, took away nearly all that the Italians had achieved, receiving in the process heavy losses. Only after the war the country was to be regained by protracted struggles. Some of the Arab tribes as well as the Senoussi and their leaders left the country.

The Italians had intended to create a grand settlement area for their people in the steppe in the north of

the country. Land was bought from the natives or confiscated from the rebels. From 1928 colonization went ahead particularly fast in Tripolitania. In 1938 about 9000 persons had settled. Another 15,000 settlers were added in the same year and 35,000 more were scheduled to arrive in 1940 for the settling of Cyrenaica in particular. Settlement occured in large-scale enterprises and through state agencies of settlement companies. Libya was to flourish more than at the time of the Romans. In 1944, these far-flung plans collapsed with defeat in war.

h) The Kingdom of Libya

In the course of World War II Libya was occupied by the English and the French (Fezzan) who also took over the administration until 1951. After long negotiations at the United Nations, a national constituent assembly was installed which offered the crown to the grandson of the founder of the Senoussi, the Emir of Cyrenaica, Sayed Mohammed Idris el Mahdi es Senoussi as King Idris I. On December 24th, 1951, the foundation of the *United Kingdom of Libya* as a free and sovereign state was proclaimed. At first it consisted of three independent countries: Tripolitania, Cyrenaica and the Fezzan. In 1963 a stream-lining of the administration was carried out and a royal order dated April 27th, 1963, with effect from 1965, divided the countries into ten provinces (Muqataa, Muhafza), each of which was sub-divided into Mutessa-fariah (districts) and Mudiriah (sub-districts).

2. The Peoples and their Social Structure

Already early in historical times *Berber peoples* lived in Libya; they called themselves Mazigh, after their own language. They belonged largely to the Mediterranean race which was mixed with a brown-skinned Hamitic type. Further miscegenations were few: in the coastal areas they occurred with Punici and Romans and in the south with Negroes (Map 12).

a) The Berbers

Amongst the Berbers the *Tuareg* have retained the greatest purity. The Romans had probably pushed them away from their former pastures in Algeria/Tunisia to the Sahara. Of these only a part of the northern group of Azger lives in Libya; they are the clans (Tribus) of the Imanghasseten and Oraghen. The Tuareg subjected the original population of the Sahara even including, it would appear, the Garamantes, adopting some of their culture.

Structure of the body: Thus a *social division* into three groups was established. First, those of superior rank (Imajeghan) who form only small tribus but hold the politico-administrative power in their hands. They are the Berber proper, belonging to the white African race. They are tall and slim but strongly built, have a long skull with a fine oblong face, strong chin and straight nose, dark wavy hair and reddish-yellowish skin.

Social division: Second in rank to the noble tribus are the servants or serfs (Imgad) who are grouped into their own tribus with their own chiefs. They are dependent in their entirity on the noble tribus; they have to carry out some tasks, pay limited tribute and assist in the event of war. They are free to acquire land and cattle and often enjoy greater wealth than their overlords.

The lowest class is made up of slaves (Ichelan), descendants of Negroes who were captured during raids. Nowadays they are free but continue in most cases, however, to live with the family of the former patron where they are employed as herders and the women as domestic helps.

A clan comprises the descendants of one common ancestor. Each clan is headed by a sheikh. Within each clan there are different, smaller families which are connected through the male parent. In the clan matrilineal descent is operative, in the small family patrilineal. Noble status, office, title deeds and titles are passed matrilineally whereas relationships between parents and children are ordered along patrilineal lines. Private property and gains remain with the small family while everything gained through collective effort or stemming from the heritage of the clan belongs to the clan and is subject to the law of matrilineal descent (Mordini). At the present day matriarchy is gradually being replaced by the Koranic law of succession.

Women enjoy great freedom. They are in the main the least educated members of family but they own property and have a voice in the council; they devote themselves to the education of the children and occupy themselves with the sewing of cloth or work with skins. Almost everywhere monogamy is now the rule. Vigorous old women frequently head the family.

Manual work is not highly esteemed by the upperclass. They enjoy breeding camels whereas the sheep and goats are left to the care of the Imgad.

The relations of the Tuareg to Islam are very lax. Although some "saints" live among them, they are inclined to beliefs in the pre-islamic remnants of animism. Genii with supernatural powers, good as well as evil, play a great role. Against the latter powers witch-doctors are employed and are often highly respected and consulted on all problems of life.

b) The Arab-Berbers and Arabs

Compared with the Tuareg the *eastern Berbers* are much more strongly *mixed with Arabs.* The first raids in the 7th and 8th centuries, although carried out by small groups, were important for the gradual penetration by Islam. The Arabs considered themselves a superior race and a racial subjugation and penetration took place only in the 11th century when the Beni Hillal and Beni Suleiman invaded the country. The Berbers conducted long and hard conflicts against the Arabs. But since the invading Orientals were of related, white stock, intermarriage was inevitable. From the 13th century marriages between both groups resulted in the creation of the *Arab-Berber,* especially in the nomadic tribes. Despite their greater numbers, the Berbers lost their autonomy as well as their language in some part. The Arabic language and script asserted themselves and national customs were supplanted by the practices of the Koran. Only in a few parts, especially in the Tripolitanian Jebel, in Zuara and its environs, in Gadames, in Augila, Siwa and other places, is a Berber dialect still spoken today and Berber customs observed. These agriculturalists did not accept the Islam which stubbornly stick to the letter, but adhered to more liberal forms mingled with remnants

of their ancient beliefs; as a result they were referred to as Ibaditic heretics (ibad — slave) by the Arabs.

Structure of the body: Physically the Berbers are more robust, being about 1.6 to 1.8 m. high; they have a strongly developed skull, an oval-shaped face and a high, broad forehead contrasting sharply with the narrow nose. The colour of their skin is whiteish-brown to medium dark-brown, their eyes are brown and their hair black. Fair hair and blue eyes as is reported at times, may only be seen in isolated instances during early childhood. More frequent, however, are negro half-castes (Fig. 29).

The Arabs are of more graceful growth, slimmer and more sinewy; they have an oval face, high forehead, black hair and black eyes and only those of pure Arab stock display the hooked Semitic nose. Their skin varies in colour from white to light-brown (Fig. 28).

As has been already noted, both the races have become largely integrated at the present day; relations between them are good. It is widely accepted that the Berbers had been sedentary whereas the Arabs were only herders and nomads. This does not seem to be correct since the Berber nomads had advanced towards the Jebel and the coast before the Arabs' invasion. Pliny too, talks of them changing their pastures and taking their tents with them. Many Arabs settled in towns as well; they apparently were not only nomads. Contrasts between Berber and Arab are small in this respect.

Social division: The sheikh as hereditary head of certain families leads the *tribus*. In some cases one of the most able family heads is elected. In the towns the sheiks preside over the quarters and the Mehallas.

Particular tribes and nomad tribus, Berber and Arab ones alike, have joined in alliances in the course of time, each alliance having adopted a special name, as for instance in the case of the Zentan who formed one of the large warrior tribus of Tripolitania. Their corporate spirit which disdains human relationship, remains a persistent threat to the peace among the tribes at the present time. They are chiefly located in Zentan-Taghermine in the Tripolitanian Jebel. They move across the Hamada el Hamra to the south as far as Edri in the Fezzan, taking their herds with them. The Megarha too, who migrate between es Shati in the Fezzan and the Gulf of Sirte, are an alliance of seven tribus of differing origins. Today they are one of the strongest tribus in the Fezzan; they used to provide the guards for the Pasha in Tripoli. In mixed alliances, Arabs and Berbers each supply one leader.

As for the Arab tribes, the so-called *Sherif Tribus* deserve mention, stemming as they do from the family of the Prophet (e. g. tribus in Zawia and Zuara in Tripolitania or in Zuila in the Fezzan), together with the *Marabut tribes* which derive their descent from saints who were generally buried in their territory and are held in high esteem. The Marabut tribes are of differing origins: Arabs or Arab-Berber. In Tripolitania such tribes are known as those of Zliten, Misurata, Waddan (Jofra) and others; in Cyrenaica there are quite a number of strong independent tribus (see map 12). They generally enjoy great respect and esteem as well as certain privileges.

The invading Arabs subjugated some tribes which they drew into dependence on them as *Marabtin* (tied ones). They have now been absorbed in the tribes or have become independent through their nomadism.

c) The Tibbu

Of the people of the *Tibbu* only a few hundred persons live in Libya in the south of the country in the Hecma wadi between Gatrun and Tedjeri, in the Wau el Kebir, in the northern Tibesti Dohone in some valleys having wells and here and there in Kufra, Rebiana, Bzema and Tazerbo. Six families live in the Auenat-Arkenu. As their bases are barren and poor in water, they are forced to move to and fro as nomads.

The present ethnic picture of Tibesti began to form only after the 17th century. Clans, especially from the southern environs as well as from Fezzan and Kufra, moved into Tibesti. Slave-hunts and trade resulted in negrofication (KRONENBERG).

Structure of the body: The Tibbu are of medium to tall height, thin but agile in running and jumping. Their features are regular, at times refined, their hair black, short and somewhat curly at times, the beard being ragged. The nose is straight, often somewhat broad; their skin-colour is dark-brown to brownish-red (Fig. 30, 31). Women are tall and sinewy too, often somewhat masculine, their hair long but little waved (Fig. 32).

Their character is described as being not particularly pleasant but rather distrustful and false, lacking in a feeling for honour and hospitality.

Social division: The Tibbu are divided into nobility and commoners. Some *clans* are more distinguished than others. These have the prerogative to provide the chiefs. In the Tibesti the Dardai stands at the head; he is elected and is the chairman of the council of the nobility. His authority is limited and confined to the office of arbitrator. The Mudir of Gatrun is the head for the Libyan area. Besides the clan, the extended family, there is the patriarchially-governed small-family.

Just as with the Tuareg, single and married women enjoy great freedom. The Tibbus generally practice monogamy, but polygamy is permitted and is practiced when the husband is frequently absent and has property in several places. During his absence his wife attends to the herds and goods.

The Tibbu were only converted to Islam by the Senoussi in the first half of the last century, the Senoussi having destroyed the Tibbu Sultanate in Tazerbo-Kufra with the aid of the Arabs and forced the Tibbu to shift. The Tibbu scarcely practice Islam although they are said to be fanatics; animism and belief in demons, are, however, still commonplace.

At present the Tibbu seem to be advancing from Gatrun. They have once again occupied the el Kebir oasis which had served the Italians as a place of exile and had been vacated by free, independent inhabitants. From here they move to the Graret Waddan on the south-western edge of the Haruj (east of Tmessa).

d) The Fezzans

The *Fezzans* (Fazazna) living as a sedentary people in the Fezzan together with the Arab-Berbers, are a people of strong racial mixture. Again the basic element is provided by the Berbers, in this case the Garamantes who appear to have absorbed some Romano-Punic blood in ancient times already but mixing much more strongly,

however, with Negroes who arrived as conquerors and later even as slaves from Bornu, Wadai, Ennedi and the Sudan from ancient times. Arab tribus (Suleim and others) settled in the Fezzan and were later joined by the Turks.

Structure of the body: The intense mixing with Negroes influenced the *physical appearance* of the Fezzans considerably. The average Fezzan male is robust, of medium stature, about 1.67 m. tall, has a broad face, a short nose, large lips and black curly to woolly hair. The colour of his skin varies from reddish-brown to black-brown (Fig. 33, 34). Women show an even more noticeable Negro influence (Fig. 35, 36). On the whole they are smaller, being not more than 1.55 m. tall; they have woolly hair, thick lips, broad noses and, as a consequence of their heavy work, frequently a concave back. They go unveiled and enjoy great freedom. Marriage is considered as a working partnership for the breeding and rearing of children. Divorce is therefore frequent.

Social division: In the Fezzan there is a distinction between freeholders (ahrar) and juajena, the children of Negroes born in the Fezzan or descendants of former slaves who have been freed nowadays. The freed slaves have generally remained with their former masters and continue in the same working conditions. They belong to the family, receive wages and as before, carry out tasks in the house, as herders and as land-workers — a job which includes the heavy duty of watering.

The nobles are, however, separated from the darker Fezzans in many respects. There are for instance two locations in el Gedid (Sebha), an aristocratic and a plebian one (en Zela) inhabited by the descendants of former slaves. Marriage between both group is tabooed by mutual agreement. He who disregards this is boycotted, no longer respected and excluded from public office; a woman of aristocratic birth for example will sink to the position of a Negro servant.

In places where customs are not so severe as at el Gedid, a black servant may be kept as a subordinate wife. This concubinage is widely practiced. Mulatto children enjoy the same respect and the same rights as legitimate ones; it is not seldom that mulattos exercise the authority of the family head.

e) Splinter Groups

This is not only so in the Fezzan but also at the Tripolitanian coast where some thousands of *Negroes* live. Nevertheless, here too marriage between Negroes and whites is not looked upon very favourably. On the other hand there are entire Negro settlements here with their own chief who is subordinate to the local authorities. There are about 5,000 Negroes living in the Tauorga oasis, four fifths of whom are Juajena whose forebears had been settled here in order to breed slaves.

Another group of half-castes among the Fezzans are the *Dauada,* who number about 200 and who live on the shores of three lakes in the Edeyin Ubari. Their ancestors appears to have come from the Adjal wadi in the north. Since then they have been joined by scarely any others and they marry only amongst themselves and live under their own chief (Fig. 37).

Another splinter group in the coastal areas is that of the *Kologli,* the descendants of Janitjaren and Turkish civil servants from different parts of the Ottoman Empire who took Arab or Berber wives or Christian slaves. Although small in numbers — there are some 30,000 of them — they provided the civil servants under Turkish rule as well as providing them today. They generally continue to marry whites even now and they live in the oasis around Tripoli with smaller groups in Benghazi and Derna.

The *Israelis* always comprised but a small part of the population. They had come to the west with the Arabs; some Berber families accepted the Jewish faith at that time. Their numbers increased after 1491 following the expulsion of Moslems and Jews from Spain. In general they avoided mixing with other races. Larger communities were to be found in Benghazi and Derna. After 1945 they all emigrated apart from a residue in Tripoli.

Apart from a group of *Cretans,* who, due to the occupation of Crete, escaped to Cyrenaica across Greece, *Italians* arrived in the country in 1911. The large settlement scheme of the Italians had to be abandoned in 1942/43 because of the last war and the loss of the colony. Thousands of Italians had already returned home and in particular was their exodus marked in the Cyrenaica; there were only about 30,000 Italians in the country, most of them civil servants, businessmen and technicians in the towns. Only a few thousand are still active as agricultural settlers, partly around Tripoli and partly in the colonies south of Misurata. A significant amount of mixing with Arab-Berbers has not occurred.

3. The Nomads, Semi-Nomads, and their Way of Life

There are only a few pure nomads left. They are the Tuareg and Tibbu in Libya, together with a few smaller ones among the remaining tribus, impoverished people who tend the herds of other tribus and move around with them. The larger tribes and even the Tuareg, show a tendency to become sedentary. After sufficiently heavy rains they sow grain (rain agriculture) and out of their income from cattle breeding they purchase palm-trees and olives which require attention and must be harvested; this means that they are occupied with agriculture and cultivation for several months throughout the year and only attend to cattle breeding for part of the year, although it does for the time being remain the most important source of income. Some of the families are forced to remain in one place for some time and thus to be sedentary, developing a form of economy which has been described as half- or semi-nomadism. For Libya this may prove to be the coming form of economy, the one best adapted to its possibilities once the right type of cattle has been bred, the dry fodder (lucerne) necessary for the dry season is provided and agricultural colleges have taught the nomads a rational kind of agriculture in the right manner. In 1954, 18 per cent. of the population, i.e. 196,110 people, were counted as semi-nomads and 8 per cent., i.e. 87,290 people, as nomads proper. Up to the present time the percentage of nomads has moved to their disadvantage. Most of them appear to have become semi-nomads and a distinction between both groups often proves difficult to make.

Even among the nomads, let alone the semi-nomads, semi-sedentary people having no fixed villages, can be encountered. Purely sedentary are the Fezzans, and of

course the farmers and settlers in the north too; lastly there are the town-dwellers who have largely lost all connections with nomadism and agriculture although possibly maintaining family links with their tribus and returning there but rarely.

a) The Tuareg

Until recently the largest branch of pure nomads in Libya was the Tuareg who shift around without fixed abode. However, they have places everywhere where they stay for relatively long periods and build huts beside their tents which remain there for an extended period. These temporary homes are sometimes only a few miles apart from one another and in any case, never near a permanently inhabited place, although always near water and pastures. From 1930 onwards, the Italian Government tried to settle them in one of the places where they remained for a longer period anyhow.

The leather tent, which is typical of the Tuareg, is not to be seen as frequently as in former times. It consists of long strips of skin from sheep or goats which have been dyed red and then sewn together; it is kept erect by a few poles and divided into two compartments, the left-hand one for men, the right-hand one for women. On the ground there is just the sand, frequently covered by skins. People sleep on a mat or rug on the sand with a garment rolled-together as a pillow. Only a few privileged people possess wooden beds. Along the walls of the tent lie the saddles and stand the wooden containers for liquids, large leather vessels for semi-liquid butter; a girba, a sheep or goat-skin with water also hangs there.

The *huts* are of cylindrical shape; they are built by women without aid from their menfolk. The framework consists of branches, the walls of tightly plaited grasses of Dis or Sbat, forming a well-joined building capable of withstanding even the fiercest winds. The huts are covered with a hemispheric dome, occasionally with a pointed roof. Roof or dome also consist of Dis (Imperata cylindrica), which is tied with finer strands of the same material. The huts are about two metres high and about 20 square metres in area; their narrow entrances are closed by a mat.

There is no division in the interior of the hut; it serves the family head, his wife and children as a place to stay, to sleep and to keep their possessions. Straw mats and goatskins frequently cover the ground. In the eastern end of the hut there is a fenced-in yard, the southern part of which is generally covered with a roof. The fence, too, consists of tightly-plaited grasses and the entrance between two overhanging fences can be closed by a straw mat. Under the open roof, supported by tamarisk poles, live the servants and garden products are also stored there. The open part of the courtyard is always kept spotlessly clean, even though sheep and goats are often taken into it to shelter from the strong winds, great heat or cold. During hot nights it is also used for sleeping.

A few yards away from the hut, outside the fence, there is a sheltered room, surrounded in the same way as the yard, which serves as a kitchen. Fire is preserved under the ashes. If the family shifts to another place the hut is dismantled and branches taken with them (Fig. 38).

There are generally three or four huts together, the groups being more than 100 m. apart from one another. Thus a village, numbering 20—50 huts, extends a long way. One part of the family together with others leaves to take the camels, donkeys, goats and sheep to the pastures in the vicinity. They then sleep behind a rock or a tree. If there is adequate pasture and high-standing groundwater permits it, gardens are laid out by men only — not, however, noblemen — and barley, maize, millet, tomatoes, onions and paprika are sown. Although garden cultivation is increasing in importance, cattle breeding still remains the most select occupation.

Milk products of the camel, sheep and goat in the form of milk, butter and cheese are the main *foodstuffs* of the nomads. The boiled meat of the same animals is also eaten and is at times supplemented by hunting with guns or traps. Apart from fish and two large kinds of lizards (warans), the Tuareg eat practically all sorts of animals. They consider themselves related to the latter and they are therefore taboo. Barley and the seeds of wild-growing gramineae alike are ground between two stones and cooked as a gruel. As for drink, they prefer sour milk and also the slightly sour, well-tasting palm wine as well as — like all Libyans — strong boiled, black or green tea, mixed at times and often flavoured with mint and groundnuts.

Dress: In former times the Tuareg dressed themselves in red and blue leather; today they prefer woollen cloth from the Sudan or Europe. They themselves do not weave. They wear white trousers with red or indigo stripes and three long tunics: a white or indigo-coloured one next to the skin and one of the remaining ones often being lavishly embroidered. The indigo colour tends to penetrate the skin so that at times it appears to be slightly tinted. Typical, too, is the veil, which is worn from the 13th year. It is black or indigo; only servants wear white. They have large sheep-leather sandals on their feet and these are also imported from the Sudan. Small leather bags, amulets in small leather pouches, even arms, a sword hanging from a leather bandalier, dagger and lance as well as a barrakan (burnous) complete the outfit which is less complicated in the case of servants. Noble women wear a woollen barrakan around their stomach and hips, with two tunics and a red barrakan or woollen cloth on top of it. The shoes are the same as those of the men. Pendants, silver coins and ingenious amulets decorate face and breast. Great care is applied to the dressing of the hair. Again, servants are attired more simply.

Men and women alike believe that they will become sick by touching water. They therefore claim to never wash. For the cleaning of clothes they use a white clay or the crushed stems of a salsolacaea which foams when brought into contact with water.

Magic: As mentioned above, the Tuareg believe in good and bad demons. Against the latter they can be supported by a magician (Imechelleauen — schamanen) who knows the secrets of the other world and to whom a mighty spirit has given a guardian spirit which obeys him and which can be called upon at any time. Already at birth the presence of a magician is required because it can happen that the newly-born does not look like his father, which means that a demon has exchanged the child inside its mother's womb. The magician sends his guardian spirit into the land of demons, makes it take back the true son and arranges another exchange by handing the newly-born child back to the demon. In

the case of an abortion as well the magician is needed. The Tuareg believe that an abortion is not caused by an irregular interference but by demons who strangle the child inside the womb. The magician seeks to bring about a normal birth through the application of amulets to the woman and to the tent.

In the hour of death the magician is also necessary. He makes the final attempts to keep the dying person alive, he watches over the dead and supplies him with the necessary instructions for his way so that the comforted dead one really does leave the earth; if he does not do so he would mean great danger for the survivors. The sleeping of women on the grave for sooth-saying purposes also appears to be the remnant of an ancient African death cult.

Magicians also exercise black magic either by evoking their guardian spirit at the time of the waning moon to bring death or disease to him, or by making statuettes from clay or cloth which they then identify with the person concerned and brake or destroy them as they recite magic incantations. The victim being informed of this will definitely be struck by disease or death. (Sedentary Tuareg [Gat and vicinity] see oasis inhabitants.)

b) The Tibbu

Small groups of Tibbu living in Libya are also always nomads even if they do have some fixed homes (see above) where part of the family stays behind (Gatrun, Wau el Kebir). The essential point is that larger parts of the population together with their herds are continuously on the move. This is not so noticeable in the Hecma wadi as they live interspersed with Fezzans there but is more so in smaller oases, as for instance in the Wau el Kebir where scarcely one third of the population could be met on a visit to the oasis.

The Tibbu live in *tent-huts* which can easily be dismantled. These consists of a framework of branches or acacia arabica, which are tied so as to form an elliptical shape. Mats are fixed across the branches. There is an entrance at one end which is curtained-off by a mat. According to the length of the intended stay the huts are two to three metres long and only about 1.2 metre high or ten to twelve metres long and up to 1.8 metres high and four to five metres wide if intended as permanent dwellings. The former are scarcely furnished at all as they are intended only for sleeping on the sandy floor, whereas the latter are divided into several rooms by strong cross frameworks about three metres apart from one another. On this framework the branches for the external walls are fixed and they are all tightly connected with each other by thin ropes; even thinner strings are used to fix the outside mats on the frame from the inside. Stooping down, the inside is reached through the entrance of matting. The entrance "hall" is not large, only some two metres wide and used apparently only for storage. Past the mat-covered dividing wall the common-room is reached. There are some mats and rugs on the floor, cushions as arm-rests lie along the walls. In the centre is some space left free to put down the coal fire while drinking tea or to place the large bowl during meals. The third room is used for sleeping.

Rolled-up mats and rugs, a chest too, stand at the wall. Pieces of cloth are hung over the framework of the dividing wall and separate it from the central room. These large huts are frequently placed inside a large yard which is surrounded by a fence of palm leaves. Here the kitchen is placed; a frame with a roof of palm leaves and one or two sides also protected by palm leaves. The fire burns in a hole in the sandy ground. Another hut of firm palm leaves is usually erected near the kitchen as a larder. Outside and in front of the entrance to the yard, another small, round forecourt is divided off by a circle of stones. This, the yard, kitchen and larder hut, are kept spotlessly clean.

There are all sorts of variations among the tent huts described; longer-established ones lack the yard, the kitchen stands detached. If the inhabitants return to certain places during their migrations, they often leave the supporting framework behind in position (Fig. 39).

Instead of matting huts the Tibbu frequently erect *seribs*. These are relatively light but well-built huts of palm leaves with a flat roof, about two metres high and often — depending on the number of inhabitants — only a few square metres in size. Three to four horizontal cross-bars of plaited palm ribs keep the walls together and they are also covered with clay against the wind. The seribs are often surrounded by a courtyard fence which also includes a protective roof for kitchen and stores or at least a fireplace (Fig. 40, 41).

As migration often involves a move of a few kilometres and the same pasture areas are visited annually, the Tibbu have erected round, stone walls in certain places which need only a cover of mats to be converted into a tent hut. In this way they save themselves the unnecessary carrying around of tent material. The walls of these round structures are built as dry constructions, about 1.5 to 2 m. high, with a diameter of 2—3 m. and they give adequate protection from the wind. At times they are made completely windproof by smearing them with loam as is mostly the case with the huts in the High Tibesti.

The *clothes* of the male Tibbu are similar to those of the Tuareg (Fig. 30): two to three tunics without sleeves, a white one next to the skin and an indigo or blue one on top, often richly embroidered ones from the Sudan, a pair of trousers and sandals of Sudanese type. To this is added a white or red cap in which the wrapping begins with the veil. They are less careful about it than the Tuareg and even allow strangers to see their faces. As for arms they carry a lance (2—3 m.) with a metal tip, a dagger attached to the arm and rarely a throwing knife and sword. On the whole the clothes of the poor Tibbu of Libya are much inferior to those described (Fig. 43).

Women wear a petticoat, a white woollen shirt, then a sleeveless shirt dyed black, indigo or a reddish hue, and a small barrakan. The ornaments consist of silver-coins, glass beads, coloured stones (amazonite) and corals. On the right-hand side the nose is pierced and a small silver ring introduced. The lips are tatooed with the aid of a thorn and a mixture of antimony, gall and coal is rubbed into them until their colour becomes dark blue. They do not wear their plaits on the head but often allow them to fall down to the back. Their hair styles change according as they are engaged or married (Fig. 32, 44). The women plait mats, weave and sometimes also do some pottery. Their leather-work is poor.

The Tibbu breed fine *animals* and in particular first-class camels of high endurance, donkeys with glossy

skins, strong goats and sheep are to be seen with them. When travelling to Kufra for their sale they generally cover the 400 km. with no losses. The animals regularly come of their own accord to drink at the Ein Zueia in the Jebel Auenat, the camels every three days, the small animals every second day. In 1958 one head of cattle made its appearance here as well, being of a small brown breed and sticking to the donkeys — a proof that in spite of a scanty water supply it is possible to breed cattle here just as in Kufra where two cattle were counted.

The *food* of the Tibbu consists in the main of milk products. To these some barley flour or flour ground from wild grasses is added. Coloquints are gathered and their poisonous seeds boiled, peeled and dried. They are then good for food and even tasty. A kind of vegetarian butter is also produced from the seeds and from this combined with dates they know how to make a type of bread that does not deteriorate fast, keeps well and is extraordinarily nourishing. Only seldom is the flesh of camels and sheep eaten. In the northern part of Tibesti (Dohone) date-palms do not grow on Libyan soil. Besides tea, palm wine is a highly prized drink. There is little gardening.

Magic: Belief in demons and animism reigns among the Tibbu as it does among the Tuareg. Offerings are made to ask for rain and there are sacrifices to the dead and atonements as well. Amulets are worn against the evil eye. The Marabut (Shamans) is questioned just as the Tuareg do; if he attends to magic he is forced to emigrate. Of interest is the sand oracle which is interrogated on every possible occasion. The liver has a certain importance in the oath-taking and also as a clan taboo.

Should somebody fall ill the aching spot is cut to make the blood flow or is burnt with glowing iron. Often scars of this sort are seen on body and head. I treated a girl with a fractured elbow joint. She had been terribly burnt at least four or five times below the joint. The joint had stiffened and hardly anything could be done. Her only function would be in childbearing. Sick people are also given butter and sodium to drink. The person is laid down, the head facing to the south, the feet to the north, two people being with him at all times. If the sick one dies the women set up a loud cry; he is washed, clothed and soon buried. The grave is covered by a heap of stones.

c) The Arab-Berbers-Semi-Nomads

The Arab-Berber tribes living between the Fezzan and the dwarf-bush steppe in the Gibla as well as in the Sirte country and northern Cyrenaica, distinguish themselves significantly in their way of life as compared with the pure nomads so that in spite of transitions they must be described as *semi-nomads.* A number of these tribus of natives are united in alliances, the most important of which in the Gibla are the Zentan and the Megarha. The former are closely connected with the Tripolitanian Jebel, the latter with the es Shati wadi in the Fezzan (A. Cauneille).

Until the Italian occupation in 1911, pure nomadism prevailed here as well, with continuous quarrels amongst the tribus over the grazing lands. Then came the confusion of the war years with flight and consequent separation from property, the drought of the year 1917/1918 with the dying of cattle, with typhoid fever and other infections among the population, followed by further war years with renewed abandoning of the hereditary land and at times even flight across the border. Only after 1930 did a certain stabilization came about and this was little interrupted by the second world war. Aided by the support of the Italians, a gradual development in the direction of semi-nomadism and thereby towards a sedentary existence began at this time. The present government supports this trend as well and attempts to create relations as balanced as possible among the returning nomads, the semi-nomads and the practically sedentary ones.

Apart from impoverished nomadic herdsmen, only three tribus of the Megarha can be described as *pure nomads.* With their black tents they migrate from Es Shueref in the middle Bey el Kebir wadi to the good pastures in the Sirte area. Their summer pastures are in the Bey el Kebir and Rawawus wadis, and here some barley and millet is cultivated by rain agriculture. They live in a state of persistent conflict and emnity with their surroundings and they are not very well liked by the people (Fig. 45).

The *near-nomads* are the first ones to depend somewhat more on rain agriculture in the wadis mentioned above and they erect their tented villages here for a longer period between autumn and spring. During summer they are dispersed from es Shueref to the es Shati wadi with their herds, where even in bad times cattle can find some food in the dunes around the Zellaf wadi. These near-nomads live in constant danger of losing their wealth and their cattle and of becoming poor. Droughts as in the years of 1917 and 1936 can occur again at any time. During the period mentioned they lost a third of their camels and half of their sheep and goats. If there is no rain in the time before harvest, they must starve. Then the nomads, easily uprooted, withdraw to established villages and try to find employment as herdsmen or labourers with the semi-nomads, or to borrow cattle (Fig. 46).

Even for the pure semi-nomads, *cattle breeding* remains important. During spring and summer they are on the move as nomadizing herdsmen but come back, however, from August till November in order to supervise their palm-trees in the Fezzan and then return to the Bei el Kebir — Zemzem wadi (Megarha) in time for sowing. The semi-nomad has got to be a first-class cattle breeder if he hopes to be successful in short-range cattle breeding, agriculture and arboriculture at the same time. He therefore sends herdsmen with cattle as far afield as the Sirte, lends them to poor people or farms them out to neighbours if he himself remains in the Fezzan (Wadi es Shati) most of the time. From the income he then attempts to buy further palm-trees or olives and figs like the Zentan. The olive-grove of the latter near their village Zentan in the Jebel is famous. They own date-palm groves in the region of Geriat and in es Shati. The Zentan are also good at building wells and cisterns; in this capacity they often travel far to the south or the north. Badly maintained cisterns easily become breeding places of malaria mosquitoes (e.g. with the Siaan in the Jefara).

The purchase of trees almost indiscernibly makes the *semi-nomad* into a *semi-sedentary man* to whom arboriculture becomes more important. Thus he himself aban-

dons his mobility and lives mostly in one of the villages of the Shati around Brak which have high percentages of former nomads. Nevertheless, here in their former base of the Ghira oasis or even in Berghin good camel breeding still takes place (Fig. 47). Here the wealthy cattle breeders have their houses. The herd, providing easy but uncertain wealth, is passed into the care of herdsmen. Much more secure incomes are afforded by the palm-trees in the Zellaf wadi.

Parts of the *Hotman* tribe live in Bergin, shifting, at least until 1939, as traders between Tunis or Gabes and Murzuq. They travelled with caravans of 50 to 100 camels and carried tea, sugar and other products into the Fezzan, a journey which took them one to two months to complete. One camel carries up to 150 kg.; there were about 30 caravans a year. Their gardens were cared for by tenants. After the war French lorries ran until 1951. In any case semi-sedentary people with their two types of husbandry, live more comfortably and are generally better off than the fully sedentary ones. To gain this state is in any case the ideal of all semi-nomads. The donkey then becomes his most important working animal.

Even the wealthy, fully *sedentary man* without cattle but plenty of date-palms seeks to approach this semi-sedentary stage by buying sheep. Some employees look after his animals and others after his tree plantations. As mentioned, the semi-nomads who have lost their stock become sedentary. They take up employment with the Fezzans or rich Megarha or wander about aimlessly, uprooted until entering the police service, the lower ranks of the civil service etc. in villages or towns.

In the *area round Tarhuna nomadism,* which was dominant there until the Italian occupation, developed in a special way. During the winter months the herds were on the plateaux of the Dahar and returned to the Jebel for their summer pastures — that is, to the areas of those villages with the main wells. Early in May, when harvesting begins, they transfer to the fields in the Jefara and the Jebel. In the Dahar (southern plateaux) cultivation occurs in only a few wadis. Since the area is relatively well rained-over and olive plantations already existed in ancient times, the Italians had reserved about 40,000 hectares for Italian settlement with tree plantations. Thus a number of nomads was forced to emigrate, chiefly to Tripoli (Brehony).

After the war the Msellam and other tribus regained their lands; the numbers of stock increased once again. Part of the country passed into the hands of wealthy nomad families by purchase, with the result that they now devote themselves not only to stock breeding and agriculture, but also to arboriculture. So the challenge to become semi-nomadic and to settle is given to other families, too, some of which already prefer arboriculture and agriculture to stockbreeding. Limestone houses are built for the winter. The government supports this trend by selling land and tree plantations and cutting down on nomadism.

In Cyrenaica parts of the *Beni Suleiman* are settled: nine tribes of *Saadin* in fact, named after their forebear Saada. These tribes (tribus) of the Jiberna (4) and Harabi (5) occupied the country as semi-nomads in a slow drift to the east about 1800. Through related tribes they have connections with Egypt; they sell many cattle there, trekking them there by way of the good pastures; as Arabs they in any case foster their liking for the Bedouin in the east who live according to the same customs, laws and attitudes as themselves.

Besides the nine tribus there are the *Marabtin tribes* already mentioned, who came from the Magreb (west) and were more or less vassals of the Saadin. During Turkish times they were still vassals who lived on the land of the Saadin. Thanks to the efforts of the Senoussi in moderating the differences in the status of the free and vassal tribes, they are now mostly independent and now no longer pay taxes for the land on which they live. The Marabtin have been partially absorbed into the free tribes and partly they live among the Saadin, enjoying equal rights, especially so the holy Marabtin tribes (precentor tribes) who originated in Morocco. Others without holy connections sometimes continue to pay taxes to a free tribe for the right to use water and soil. Most of the pure nomad groups in Cyrenaica are vassal tribus, who consider themselves to be independent, however. Some of them move between Fezzan, the Nile and the Sudan and wander wherever they please where there is grass and water.

The home of the largest part of the tribes is situated in the Jebel Akhdar, where they also cultivate land. Here the land ownership is tied to strict laws. Only a few kilometres south of the watershed of the Jebel Akhdar (of the Tariq Aziza) land ownership ceases. Only the well remain established property. After the first rain they move to the pastures in the south and return with their herds in the dry season in order to be able to let them drink. These more nomadic parts of the tribus with their sheep and camel herds are usually wealthier than the more sedentary ones with cattle and goats who shift but little and send camels and possibly even sheep away with the former. In November, the month of the sprouting grass, the ewes lamb; in December, after the ploughing and sowing of barley, the move to the south, which is warmer for the lambs, begins. Until the middle of April animals, even horses, need no drink. The harvesting starts in the Barce plains and at the coast and goes on from May until late August in the highlands. The barley and wheat crop is usually good so that it is possible to endure even some lean years. The grain is stored in holes in the ground and in old tombs (Evans-Pritchard).

Until about 1930 the land was in the hands of the Saadin tribes. Then the Italians began with expropriations in order to settle their own people. This was not possible without expelling and exterminating some of the semi-nomadic tribes who rebelled against them. After the war the semi-nomads returned to their accustomed way of life. The present government has also tried to make at least some of the semi-nomads adopt a sedentary life. Although at first seen living in their black tents next to the empty houses of colonists, which they use as cattle stalls, for instance in the former Italian settlements at Fasura (Baracca) and at Barce, it was not noticeable in more recent times that some houses were at least temporarily inhabitated and the gardens cultivated. Parts of the bush in the Jebel Akhdar had been fenced so that they could develop into proper forest, a development prevented so far by goats and nomads in search of wood. Only on the southern slope and outside the Jebel larger herds, kraals, summer houses and tents can still be seen in addition to permanent settlements with small olive groves here and there. So it is that sedentary semi-nomadism progresses here as well.

The *Arab tent* is the usual home of the semi-nomadic and nomadic Arab-Berber. In many cases it is scarcely moved from its position, although it is generally practical to alternate the winter and summer type of tent. In summer a tent made only of white strips of wool material is used and this does not absorb the sun's rays whereas the heavier and warmer winter tent is made of black camel and goat hair. Some tents of poor nomads consist of nothing but rags patched together and stretched over a wooden frame. It is, however, windproof and warm inside. In most cases several tents lie next to one another (Fig. 45, 46).

In summer the semi-nomads move from the Gibla to the Shati wadi and take their tents with them. Those who do not own permanent houses there have erected walls of mud and gravel about one metre height and the size of an Arab tent, across which the tent, if possible the oldest sections, is secured with the aid of poles and ropes. In front of the tent, which is often protected against the wind by a low wall, an open, walled-in space remains for the kitchen. The interior of the tent is divided by tent-sections, the better part serving the men as sleeping quarters and storage room for valuable objects.

Tent-houses are always situated outside the oases away from the stone houses. They form groups of some ten tent-houses, each about ten metres away from the next at intervals of about 1,000 m. between individual groups, mostly located in wadis and depressions, sheltered from wind and rain.

In winter some semi-nomads live in permanent homes together with sedentary people. The houses are simple box-shaped structures of loam and gravel, mostly white-washed (gira) or two-storeyed as in Berghin (vide oasis inhabitants). These houses too, form groups, always remaining, however, at some distance from one another. The villages are small and irregularly built. Some houses can boast a vaulted roof (for instance at Misda and its environs). At Tobga and other places there are cave dwellings driven into the mountains. In some nomad's villages schools have been recently established (Fig. 48).

Their *dress* is less colourful than that of the Tuareg. They wear long, white linen trousers and a white, long-sleeved shirt, reaching down to the knees. A white or coloured woollen cloth across the midriff keeps it together. A colourful pullover is worn above the shirt with woollen barrakan as an alternative. Sandals or a type of shoe, often cut from the rubber of discarded car tires, are on their feet; a white cap or red fez covers the head.

Women wear dark barrakans, which serve as veils at the same time. Beneath there is a long shirt. The nomads dislike seeing strangers in the vicinity of their tents as their womenfolk often work there without a veil. They weave tent strips from wool as well as bags for journeys and sheepswool barrakans. The Arab-Berbers tend to buy the wives for their sons. Although Mohammedans are permitted to have four wives besides their subordinate wives, high costs have more or less effected monogamy. Divorces are easily obtained but are not frequent because since the Italian occupation the husband has been legally obliged to look after his divorced wife — a custom that was retained. Men rule over women; the course of their lives is exclusively determined by the father and later by the husband. The girl remains with her mother during childhood; she is taught all domestic duties and assists in the upbringing of younger brothers and sisters by watching over them and carrying them around. On the commencement of puberty she starts to wear the veil. At about the age of six boys join their father, by whom they are introduced to the men's work. By the time a boy reaches the age of 13 or 14 he must be circumcised. Circumcision is celebrated by a family feast.

Food: The foodstuffs of the semi-nomads are more varied, if only because of their close proximity to sedentary people. They harvest dates and olives, apparently also figs and pomegranates or are in any case able to obtain them on an exchange basis; likewise with melons, onions, paprika and other items. Wheat for their own consumption, barley and maize, they mostly grow themselves. Apart from these they have milk and dairy products as well as meat from their stock.

Magic: Doctors (Tabib) move from tribe to tribe of the Arab nomads; although ignorant of clinical diagnosis and confining themselves to branding, they do at least have some surgical skills, especially where repositioning and healing of fractures are concerned. Otherwise amulets and incantations are employed to cure as it is believed that spirits cause disease and death apart from making all sorts of mischief such as disturbing people's sleep, causing nightmares, deflowering girls etc. Most feared are female evil spirits which may adopt the form of an animal, a snake for instance, or may, as a night bird, announce the death of a child by their screeching. Should someone become active as an aggressive exorciser, he will be chased away.

4. The Sedentary People, their Settlements, and their Way of Life

a) The Oasis Inhabitants of the Fezzan

In the desert oases south of the Libyan steppe there are more sedentary people than there are nomads and semi-nomads. The most extensive oasis areas are in the Fezzan between Ghat in the west and Tmessa in the east, el Fogha in the north and Tegerhi in the south. Far to the east and outside the Fezzan, there is the small group of the Kufra oases. All oases lie between 24° and 28° N. In spite of their high fertility the oases of the Fezzan are only thinly populated. The majority of the inhabitants are dark Juaschena, often the descendants of former slaves; there is only a small number of Arab-Berbers and sedentary Tuareg in the west.

Between the Fezzan and steppe areas there are a few oases dotted about between Ghadames and Jaghbub in the east. They lie between 29° and 30° N. Like the adjoining pre-desert areas they are predominantly populated by Arab-Berbers or Berbers who have been sedentary for a long time, or by semi-nomads turned sedentary.

During the war of the years 1914—1922 the sedentary people and especially those in the Fezzan, suffered greatly. Under the leadership of the Senoussi, the Italians were beaten back to the coast and then, as had happened so many times before, nomads penetrated the Fezzan from all sides, plundered the date reserves and the grain, robbed the inhabitants even of their clothes and their few ornaments and burned houses and huts. Some villages were completely destroyed and deserted by all their inhabitants; in every village there were houses destroyed. The traces of these events could still be seen in most recent times. The Fezzans hid in the date-palm thickets

or fled, some as far as Tunis. On top of this came the hunger years, particularly 1917, when flour was made from the trunks of date-palms and green grain and shoots from the plam trees — thus killing off the trees — were eaten. Mortality was high, especially among children.

Kufra was only conquered by the Italians in 1931. Many people died in flight; el Jouf, the headquarters of the Senoussi, was partly destroyed at that time and totally so during World War II. Its reconstruction only started in 1958, the father of the King together with other members of the family being buried in the mosque there.

The inhabitants of the oases are mostly agriculturalists. Their garden are situated on the fringe or in the palm groves and must be irrigate. Palms grow where the groundwater stands high and are surrounded by hatiets, poor pastures consisting of sparse bush, palm thickets and few grasses. Gardens change in size from about 30 : 200 m. and are divided up into many small squares, across which the water is distributed. The soil is worked by the hoe. The gardens are distinguished according to the type of irrigation, whether by spring (uta) — occuring almost entirely in the Wadi es Shati —, by wells with the aid of a balance pole which is weighed down by a stone (kettara), or with the aid of a goat or sheep-skin bag which is emptied by stretching the U-shaped bag over two pulleys across a firmly built-in framework (dalu) into the channels (sekia). The ropes of this construction are pulled by a man and donkeys walking down a gradient. The bag holds 15—25 litres of water. In the hot season the pulleys of the dalu may be heard creaking half the night until the morning hours. A leather basket hangs down from the balancing beam of the kettara, which is pulled up by a man standing across the well and emptied into a trough made from half a dug-out tree trunk. Palm-leaf fences or walls protect the wells and gardens (suani) on those sides most affected by the wind (Fig. 26, 27).

In winter mainly wheat is cultivated (second half of October to March/May) on lighter soils and, where less water is available, barley and as vegetables, peas, beans, carrots, turnips, onions, some garlic and mint as well as turnips for sheep and donkeys. In May, when the winter crop is harvested, millet and more rarely maize, is sown in the same field. Due to high evaporation and often a lack of water, the harvest is not too plentiful. Likewise tomatoes, red peppers, melons, cucumbers, coloquints and aubergines are planted then, frequently supplemented by some tobacco and a little cotton — plants which were introduced by the Turks. Lucerne survives for several years if well fertilized. The young January and February shoots are eaten; from March till November there are several more cuttings to provide fodder for goats, sheep, donkeys and cattle. Plantations with lavish irrigation wash the soil out to such a degree that it has to rest for one to two years. Only one third to a quarter of the garden is cultivated then.

The most important fruit tree is *the date-palm.* Irrigated trees and especially so in the Wadi es Shati, bear relatively ample fruit, 15 to 35 kg. on average. Most trees are artificially fertilized by the natives since there are relatively few male trees. The man who carries out the fertilizing receives one eighth of the crop in return. He pollinates about 25—30 trees a day. Without this treatment the trees only bear up to 5 kg., reaching double that if the roots touch the groundwater. There are about 850,000 palm-trees in the Fezzan; their production fluctuates between 1,000—2,500 tons a year. Only the best varieties from Shati and Buanis are suitable for export. When incised at the top the tree discharges palm-sap which makes a refreshing drink (lagni). This practice, however, easily leads to killing off the tree. Apart from timber for building purposes, fibres for ropes, baskets and camel saddles are all gained from the tree.

All other fruit trees need more frequent irrigation. There are figs, almonds and pomegranates in the gardens and at times agrumes and olives as well. Because of its oleonaceous fruit the castor-oil shrub has recently been introduced.

The sedentary people keep but few *stock;* one family generally one to three sheep or goats, preferring the former because of their wool and milk. There are next to no cattle as the hatiet in the vicinity of the oases provide too meagre a grazing ground. The working animal is the donkey which is used for the purposes of irrigation as well as for load-carrying. Camels belong in the main to former nomads now partly making their living from trade. There are still about 500 horses in the Fezzan, owned by wealthy Arabs.

Arab-Berbers are the greatest land-owners, the largest part belonging to them with the majority of Fezzans as tenants and labourers. Smallholders work their own gardens and possess a few date-palm trees and animals, but on the whole they do not enjoy a much higher living standard than the tenants. Irrigation of the gardens, which is the hardest work, demands about 10—12 hours daily. At most 40—50 "are" are irrigated with the aid of two donkeys and such an area yields a maximum of 350 to 450 kg. of grain in winter, three quarters of which go to the owner and a quarter to the tenant. Provided further yielding wells are at hand, the employment of wind and oil motors allows larger areas to be irrigated. But in this event sufficient numbers of mechanics must be available for necessary repairs. By using artesian wells, with a quantity of 70 cubicmetres/h., over-irrigation of the soil may easily lead to leaching out or even salinization.

Thus for the Fezzan *returns for its labour* are small. Grain is supplemented by gathering wild graminaceous seeds which are ground in hand-mills between two stones and worked into a gruel which is eaten together with relish. Truffles, too, are gathered and seem to be very popular. There is little meat; boiled mutton and chicken are added to the kuskus of coarse grain or millet. A sort of bread is made from unleavened barley dough. Chickens provide eggs. In an attempt to supplement meat supplies, gazelles, waddans, hares, mice and some large lizards are trapped. Locusts, boiled, crushed and mixed with date flour are also popular. Fat, oil, butter and some dried-meat is bought from nomads. Besides sour milk and palm wine the most popular beverage is green or black tea, chiefly of Japanese origin, which has been imported from Asia, or even a mixture of both kinds of tea with groundnuts or a few leaves of mint added. Together with sugar and other products it is imported by traders from Tunisia.

The wives of the Dauada fish small crustaceans (Artemia salina) and algae from the Bahar ed Dud and Bahar et Trona with small linen bags; both are then mixed in certain proportions with one another, dried and pressed

into a sort of cake (duda) which is eaten in that form or used as a relish by the Fezzans. Other cakes are made from algae alone or from the larvae of ephydes living in large numbers on the lake shores.

In spite of hard work, the Fezzans do not succeed in making more than a meagre living. So many move away to the coast in any attempt to improve their lot, however, and this in turn means a loss of manpower for the oases, for their wells and their gardens. The government has therefore endeavoured to keep them bound to the soil by giving land to tenants and labourers and making them small landowners as well as easing the strain of irrigation work by supplying them with small mechanical pumps.

The *dress* of the poor Fezzan scarcely differs from that of the semi-nomad. A short linen shirt is kept in place by a belt and falls over a pair of wide pleated trousers. Sometimes a barrakan of wool or linen is worn. Broad sandals with double leather soles are secured by a thong which runs between the first and second toe. The poorer people even use rubber from car tires or palm leaves for their sandals. On the head a little woollen cap is worn or a turban made up from a towel and in turn covered by a barrakan. The hair is shaved but a tuft is usually retained.

Women wear a long tunic of blue wool — often over a shirt —, a belt which serves to gather the gown and a broad, dark, square headscarf covering face and body. Their sandals are like those of the men but are on occasion embroidered. As for ornaments, large silver earrings are worn, often held by a strip of leather passing over the head; necklaces of beads with silver pendants, silver or leather bracelets embroidered with colourful glass beads as made in the Sudan are also to be seen. Some women wear a small silver ring in the pierced right side of their nose.

The hair of women and girls is usually arranged in numerous plaits which hang down over the ears. Hair styles vary somewhat; they are intended to indicate the married or unmarried status of the female concerned. The entire body from the 10th or 11th year of age is divested of hair by depilation (Fig. 49, 50, 51).

The women of the Fezzan assist in agriculture by tilling the soil; on the handicraft side they spin wool which is bought from nomads and weave it into blankets and children's barrakans. Mats and baskets are plaited from palm-leaves; pots and other vessels are made from clay by the coiling method, first being dried in the sun and then burnt. When they are still very young they are made to do domestic work such as fetching water, gathering firewood, washing the laundry and supervising and carrying about their younger brothers and sisters.

The wealthy Arab-Berbers wear more distinguished clothes: colourful, embroidered waistcoats and a white, woollen barrakan. Their goatskin shoes too, are frequently embroidered in many colours. Women cover their face with one corner of their barrakan so that only one eye can be seen (Fig. 28).

The *villages* of the Fezzan are generally situated near the cultivated lands, in or on the edges of the oases where water occurs. They are mostly small, the *houses* with walled courtyards irregularly adjoining one another. Unhewn stones, small blocks of salt-clay and sun-baked bricks joined with simple clay mortar serve as building materials.

Narrow lanes wind their way in circles through the buildings without any connections to the outside. The outer walls of the houses which are on the periphery of the settlement, tend to form the external walls of the village at the same time. Only rarely does a house rise above the rest with an additional second floor. Some villages are built round an old fort, the remnants of which, now being used as a police station, lie in the centre together with the market as in Zuila. Zuila even boasted an outside wall with protruding towers and battlements similar to those at Murzuq and built from large square blocks. It surrounded the town as a square, remnants of which can still be inspected. On entering a village, one finds oneself between grey walls which are interrupted by closed wooden doors every now and then. At times the lane is spanned by small arches of the upper floor of one of the houses. Then again there is a half-collapsed wall, a gap in the ruins and one finds oneself in front of a small mosque with an inclined minaret. Only rarely is a wall or house centre-piece whitewashed, grey being the predominant colour. The village gives a derelict impression. Here a woman slips across the lane, there a few shy children scamper away. At times old men sit together on a bench in some shady corner (Fig. 52, 53, 59).

Poor seribs, huts made of cane or palm leaves, stand scattered in front of some villages. There are also larger houses, well-built as permanent dwellings, which are combined into villages in some parts as for instance in the Hofra. In the vicinity of Ghat, for example, the descendants of slaves inhabit them. Quite different from everything traditional is Dar el Bey, the new town of Sebha built for civil servants after the war in the sandy, barren country between el Gedid, el Gorda and Hadjara. With its government buildings, the royal villa, the large hospital and the modern, whitewashed flat-roofed houses with their gardens, it gives the impression of a colonial town of European style, especially at night when it glows lonesomely in its electric light. A tarred road, 950 km. long, connects it with the coast.

The simple seribs which are built in the same manner as the temporary homes of the nomads, have already been cited. Those intended as permanent homes are more solidly and more carefully constructed; often several courtyards are made to join up with one another (Fig. 40, 41, 42) and at least one room, intended as a common room during winter, is plastered with loam or built in brick (Fig. C). Family life takes place in a court roofed over with palm leaves. From here, further rooms and the kitchen are reached. Visitors are received in the entrance court.

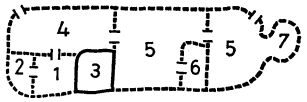


Fig. C. Seriba, Wadi Etba in the Hofra and near Gatrun (according to Despois): 1 covered courtyard, 2 room, 3 winter-room, 4 entrance-courtyard, 5 inner courtyard, 6 kitchen, 7 fence for animals.

The little dwellings of the less well-off people in the villages are often much poorer. A narrow yard, surrounded by a 2—3 m. high wall, is entered through a door made of palm boards. A low wall or fence in front of the entrance prevents a glimpse of the interior. In

one corner of the yard there is a stone-built, roofed room where family life takes place; a somewhat elevated (about half a metre) part serves as a place for sleeping on mats or possibly blankets. To this solidly-built section the kitchen is added. It is divided off by palm-leaves or branches and followed by yet another palm-leaf covered room which is used for storage of goods and provisions and in summer probably also for sleeping. The soil is everywhere covered by sand. At the end of the court there is another fenced-in section (closet) for chickens and animals which are occasionally taken out with them.

Apart from these primitive homes, larger ground level dwellings, too, may be found in the villages (Fig. D).

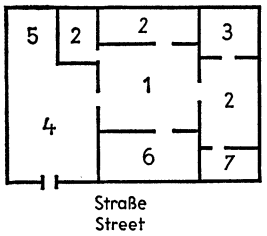


Fig. D. House in Bendbeiya, Wadi Adjal (according to Despois): 1 covered courtyard, living-room of the family, 2 room, 3 kitchen, 4 entrance-courtyard, 5 stables, 6 shed, 7 lavatory.

From the entrance court the roofed living-court is reached, surrounded by several rooms, as well as the kitchen, and from here or one of the short winding passages which prevent visitors from catching sight of family life, also the closet is reached. A hole or a slot in the ground secured by palm logs leads to the pit which in most cases is accessible only from the outside. The ceiling of the rooms lies over halved palm-beams and consists of tightly-packed palm-leaves or straw which at times may be plastered with loam. Pest such as scorpions, like to make their homes in the palm-leaves. The floor of the roofed court and the rooms consists of tamped loam or simply of loose sand. Frequently it is covered by plaited straw mats which are used for sitting down or sleeping. Carpets are more rarely found. Since the houses are only built of sun-baked bricks, heavy downpours are likely to make parts collapse when the bricks disintegrate. Then new building additions are carried out and at times even derelict or deserted building in the vicinity are included.

Two-storeyed houses are more solidly built. The round-cornered Berber houses of Bergin in the Fezzan have already been mentioned; some of them have a room with adjoining roof-terrace added, intended for the exclusive use of the women. The terrace is reached from the courtyard by way of a staircase. Houses in places like Ghat for example, are similar although at times somewhat larger.

The houses of the wealthy Arabs in el Gedid for instance, are much better finished (Fig. E); in one of the courts on the groundfloor they have their own well together with a bathroom, closet, rooms for the storage of foodstuffs and possessions, a stable and, adjoining the entrance court, a large room for the reception of guests. Its ceiling is supported by beams and joists, carpets and mats cover the floor, and at times even the walls are decorated with pictures. The upper floor with several rooms, kitchen and large terraces is kept spotlessly clean. Here the family life takes place. Above all it is intended for the women of the house who retire, however, whenever a stranger comes to visit these quarters. Quite unlike the dark wives of the Fezzans, the white women of the Arab-Berbers are never seen by strangers.

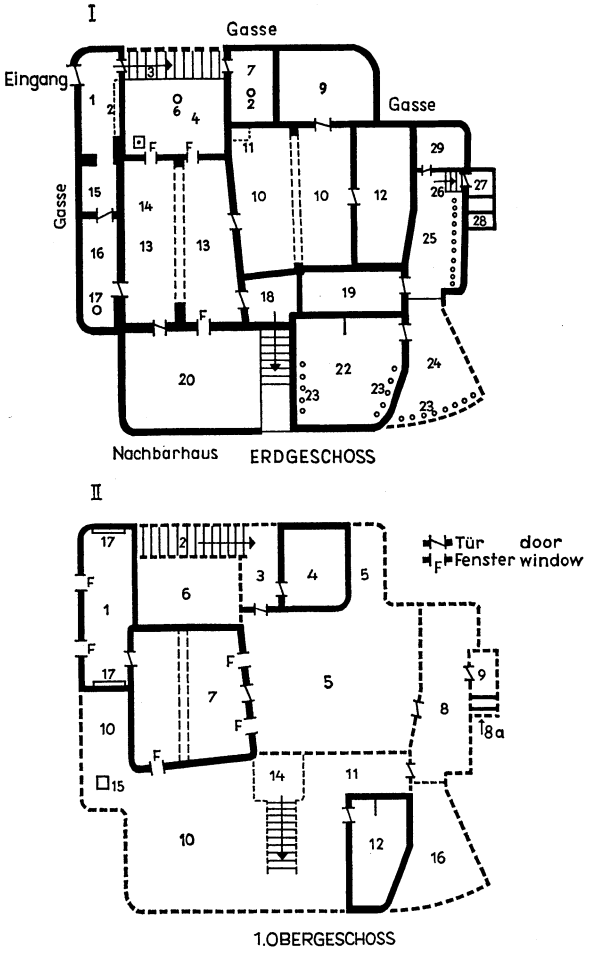


Fig. E. Big House from El Dschedid (Gedid) (according to E. Scarin): Street, Entrance, Adjoining house. *Groundfloor:* 1 entrance-hall, 2 stone bench in the entrance hall, 3 stairs leading to first floor, 4 open courtyard, 5 well, 6 pit serving as drain for rain and well-water, 7 bathroom, 8 small water-basin, 8 a seat with small aperture over 28, 9 storage-place, 10 large covered room, 11 small partition-wall for dates and similar stocks, 12 storage-place, 13 large room of the groundfloor, 14 thin partition-wall, 15 small corridor, 16 corridor leading to the large room, 17 light-well (in the ceiling), 18 part of the covered corridor 19, 20 storage-place, 21 second staircase leading to first floor, 22 covered stables, 23 cribs, 24 open stables, 25 shed for other animals, 26 small staircase leading to lavatory, 27 lavatory, 28 well leading from the first floor to the cesspool, 29 shed for other animals than horses. *First Floor:* 1 reception-room, 2 staricase leading to the first floor (= No. 3 on the ground-floor), 3 open entrance to first floor, 4 small sleeping-room, 5 open central terrace (courtyard), 6 small courtyard of the ground-floor (= No. 4), 7 large living-room, 8 second small terrace, 9 lavatory, 10 terrace for the drying of the crops, 11 terrace corridor, 12 kitchen, 13 staircase leading to the first floor (= No. 21), 14 open part of the corridor on the ground-floor (= No. 18), 15 light-well (skylight) (= No. 17), 16 open stables of the ground-floor (= No. 24), 17 book-shelves.

Scale: 1 : 300.

b) The Oasis Inhabitants of the Northern Desert and the Tripolitanian Jebel

On the whole the oasis villages of the northern desert make an impression similar to the Fezzan. They are still demolished in parts. New buildings are often whitewashed or of an earthy colour in spite of the walls being smoothened over with clay. And yet every settlement has its own individuality. Jaghbub for instance is noted for its new Koran School and even more for its large white dome over the Gubba, the mosque containing the tomb of the founder of the Senoussi Order. In the group of oases of Jalo the Jikerra village consists entirely of seribs; even the mosque with its minaret is built from palm-leaves. In the other oases the houses and their gardens are threatened by advancing sand, against which palm-leaf fences have been put up for protection. Marada has been partly re-constructed at the foot of the old fortified Gara; it consists in the main of widely-spaced homes which are protected by walls.

In Socna which had been almost completely demolished inside its old wall, new and mainly whitewashed houses are grouped around the old Berber castle and its market place. In the Tripolitanian Jebel, the old ruined Berber strongholds together with their surrounding villages were situated on the precipices of the escarpment. In some places like Garian or Tarhuna, the strong Italian influence is now beginning to make its impact. Except for the minarets, a large part of Garian village in particular has a southern Italian character. In the vicinity only the houses of former Italian settlers appear to be somewhat adapted to the Arab style of building thanks to their heightened roof-corners. But from Garian to beyond Nalut the ancient Berber cave dwellings can be found and they are still made at the present time. Most impressive of all is Ghadames with its large palm-grove, its walled gardens well irrigated by springs, its narrow lanes bridged in places by buildings and its multi-storeyed houses (Fig. 54, 55).

The inhabitants of *Ghadames* are Berber, still speaking a Berber dialect today and maintaining, as wealthy businessmen, connections with Tripoli, Tunis and the southern oases. Even outside the oasis there are single-storeyed, partly grey and partly whitewashed houses in the south-east. There are shops along the access road and the school and hospital are on a low hill; a graveyard extends along the slopes and around the white memorial to a marabut. The older walled settlement extends to the oasis and here, between gardens and palm-trees the old, some ten metre high Berber houses stand close to each other. Their foundations are made of stones and above the groundfloor they carry two more storeys of grey unplastered bricks. Only the highest parts of the walls with their heightened corners, which are supposed to give protection from evil spirits, are whitewashed. On the wall of the terrace lies a potsherd which is to keep away the night bird which causes the death of children. The first storey frequently juts out over the groundfloor, thus forming an overhang above the lane below or even built across its entire width (Fig. 21).

The groundfloor is entered through a door (Fig. F), which is protected from the evil eye of others by gazelle or muflon horns. Apart from passages, a staircase leading to the first floor and a pit opening to the outside, it contains a large storeroom for goods, wood and foodstuffs, but being the coolest room it also is used for sleeping during the hot season. The most important room of the house is the Temenaht, the reception wall, which extends through both the upper storeys and receives light through an opening in the roof-terrace. The rooms of the first floor are reached through the hall and those of the second floor and the terrace by a staircase. The closet, a simple hole in the floor, is located in a narrow room on the first floor above the pit.

At its door the Temenaht is richly decorated with gypsum ornaments, the doors painted with stylised plants and floors. Together with pans and medallions, copper vessels, the wealth of the house, hang in rows close to one another along the walls. Copper vases, brass plates, samovars and clocks stand on wall shelving and there are pictures here and there showing oriental landscapes. Plaited mats and precious carpets from Kairouan, Arabia and Persia decorate the floor and cushions lie along the walls. The roof terrace is the preserve of the women and no stranger is allowed to enter it. Here is the kitchen with stoves as well as iron and leathern pots and the terrace room where the parents sleep in summer, separated from their children. There are con-

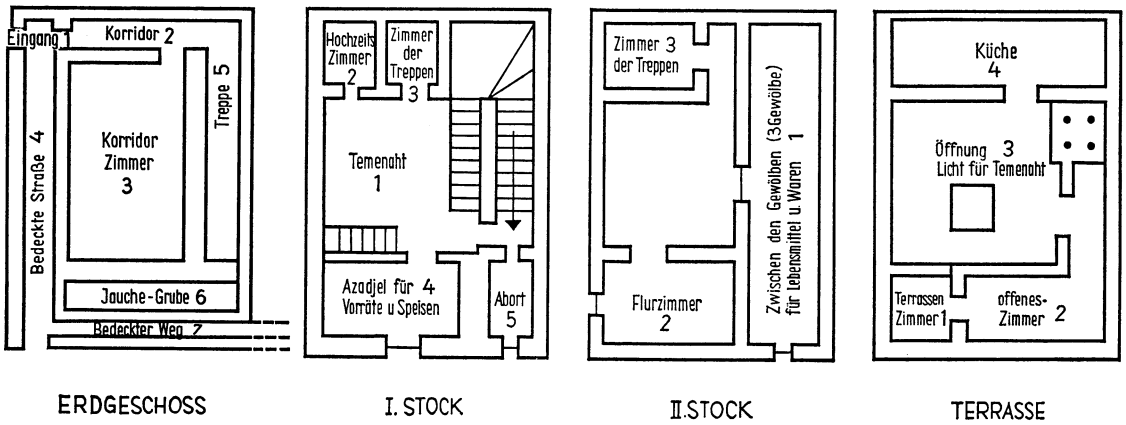


Fig. F. House of Berber in Gadames (according to Cpt. Aymo). *Ground-floor:* 1 entrance, 2 corridor, 3 hall-room, 4 covered street, 5 staircase, 6 cesspool, 7 covered way. *First Floor:* 1 temenath, 2 marriage-room, 3 staircase-room, 4 azadjel for stocks and food, 5 lavatory. *Second Floor:* 1 room between the (three) vaults used for storing of victuals and other goods, 2 hall-room, 3 staircase-room. *Terrace:* 1 terrace-room, 2 open room, 3 opening, light for temenath, 4 kitchen.

nections from house to house so that women can visit one another without entering the lane.

Another characteristic form of Berber housing is the *cave dwelling* of the Jebel already mentioned (Fig. 56). This is a square shaft of up to eight metres width and vertically six to eight metres deep, driven into the loess-like soil. A reddish-yellow loess, 4—6 m. thick, lies on top of lighter coloured material filled with limestone concretions and also firm, greenish, marly sediments with gypsum crystals which are separated from the loess by a limestone crust. It is in this firmer, lower stratum that entrances to individual rooms have been dug from the bottom of the shaft. The only light these rooms receive comes through the door. Some of them serve as living and sleeping rooms, one as a kitchen, one as a stall particularly for the chickens, and one as a closet. The storerooms for goods and foodstuffs are mostly situated above the living quarters and can be reached by ladders. The bottom of the shaft lies so high that it remains dry even at the highest groundwater-level and stands at times above the base rock of limestone and sandstone which is impermeable to water. In a hole at the centre of the shaft bottom, which serves as a rubbish dump, rainwater sometimes accumulates. The top of the shaft is entered through a door that opens to a winding passage with several steps leading down to the courtyard (Fig. 57).

The cave dwellings in Zintan often vary slightly. A short and open access leads to the courtyard, from which rooms, worked into the hill, are reached. In Tobga the rooms are reached directly from the surface of the slope way of a short, closed horizontal passage (Fig. 48).

The cave dwellings are mostly poorly furnished as are all the homes of the poorer sections of the population. In Gharian I visited the cave dwelling of a wealthy man which was located near his surface home and could be reached from there. Next to the lower entrance to the courtyard there was a stall for goats and chickens on the left hand and the kitchen on the right; the latter contained a small stove for baking bread, next to the open fire. Water was kept in large earthen vessels. The vaulted visitor's room was whitewashed, numerous colourful plates and vessels were lined up on the shelves, pictures hung down on cords. The ground was covered with mats, and mats also hung in front of the entrance to the room behind, in which a curtained bed stood. Everything was very clean. Further rooms were locked with doors. One served as a retreat for the newly-wedded bridal pair where the young wife must spend her first fortnight. People retire to the cave dwellings in summer because the effect of the dark radiation of warmth already ceases a few metres below the surface, these dwellings are warm in winter.

In Misda I visited a courtyard surrounded by buildings with roundish roofs. It was reached by way of a narrow passage in one of the houses. Some of the houses were single-storeyed and others had a second added. The upper rooms (lofts) could be entered by using a ladder or narrow, unprotected and projecting steps on the outside wall. Living rooms, kitchen and stalls were beneath. The arrangement gave the impression of a surface cave dwelling (Fig. 58). Three solid conical towers made of stone, located in the upper part of Misda village remind the visitor of the former struggles between both tribus of the Berber Gontrar who make up the population of Misda. The highest tower which has embrasures, rises to five storeys (Fig. 59).

In most of the larger oasis villages there is, if not a hospital with one or more semi-scientifically trained doctors as in Sebha, Murzuq, Kufra and others, at least an *ambulatorium* with a trained medical orderly. The doctor attends on a rota basis or on demand. Gradually the population gains confidence in the doctors and comes for treatment. The simple Mohammedans think of diseases as sent by Allah as retribution for their sins. If he has decided on recovery, he allows the doctor to heal the sick one. Diseases are caused by Allah who uses constellations like the Plejads which produce diseases, or the phases of the moon, or humans bringing misfortune by their evil eye or by evoking and using the aid of evil spirits and genii for their wicked deeds. The universe is full of these male and female genii who appear to have been the first inhabitants of the world and to whose occult influence humans are subject. They are therefore both feared and revered by sincere Mohammedans (Denti di Pirajno).

c) The Inhabitants of the Towns and Settlements Near the Coast

In their design and manner of building the *towns and settlements on the coast* and near it have been most influenced by Europe, especially by Italy. New town centres and business streets have a southern Italian atmosphere about them. This form has also been adopted by certain of the indigenous people. Their houses have an entrance door opening directly onto the street and they frequently even have windows. Only on the side adjoining the coast are there rooms without windows, accessible by one door from the outside and serving the family life. There is a large walled courtyard, often divided into two because of the harem, sometimes containing a few trees and with a closet at the rear. Modern times have made many courtyards accessible from the street as well so that cars could enter and be parked and unloaded and goods stored there. Nearly all settlements have, however, preserved the old Arab style of building in some parts of the town (Fig. 60).

Italian settlers' houses taken over by native settlers in the vicinity, have two to four rooms with windows which are frequently covered by blinds on the roadward side because the small backyard with sheds and outhouses is hardly suitable for Arab family life. So at first the semi-nomads of Cyrenaica preferred life in a tent next to the settler's house, the roof of which had indeed often been damaged. As far as agriculture is concerned, the nation has adopted cultivating methods in gardening, arboriculture and grain production with irrigation or rain agriculture which the Italians had introduced.

Generally the towns still have an Arab quarter. In *Tripoli* this white, old town is still situated within the partly preserved town wall which adjoined the fort (Fig. 62). The lanes are narrow, the houses single-storeyed and in parts with roof terraces. They are entered by way of the courtyard with its business and store rooms. Some one or two-storeyed houses of the wealthier people have their court situated at the centre. From there the lower, windowless rooms are reached, the upper ones from a gallery running round. Here facing to the rear as well, are the women's sections. Larger houses such as these are often rented out to several families. Each has a window-

less room, opening to the courtyard or to the gallery; four to five families share a kitchen and closet (Fig. 61).

The ancient business and artisan streets where people engaged in the same jobs live together, are still preserved in parts.

One small shop adjoins the next; the lanes are permanently covered or at least screened-off by mats as protection against the heating up of the ground in summer. But quite a few houses in the old core of the town have in recent times been transformed or newly built.

In the south and east stretches the new town, already laid out by the Italians, with its broad streets, government houses, large hospital and one to two-storeyed private properties (Fig. 63). Water supplies and sewage are provided for here as in every other large town. Nowadays older building are even pulled down in order to make space for 9—10-storeyed blocks. In the south-west there is a residential quarter with villas in European-American style under construction, equipped with all conveniences at a corresponding cost (Giorgimpopuli).

Over the recent years numerous people arriving from the oases in the hope of finding easier and better-paid work in a big town, have formed a slum quarter on the southern fringe of the city. People live in poor huts which stand close to each other and are made of tins, wooden boxes and sacks and lack even the most rudimentary hygiene requirements. The government is attempting to call a halt to this misery and to prevent the formation of further slums by a building programme for simple houses and by repatriating the emigrants to their home areas.

Conditions in *Benghazi* are similar to those in Tripoli. Some parts of the city had suffered severely by the war. Here, too, an Italian-style part of the town borders directly on the old Arab part. A new Arab quarter is under construction in el Berka. There are only a few slums and the huts of corrugated-iron sheets are better built. To some extent it owes its continued existence to the fact that no rates are levied here. There were difficulties over water supplies which, it is hoped, will be overcome with the construction of a water supply-line from karst springs. On the Jebel Akhdar, *El Beida,* a new town, has sprung up with government buildings and residential premises of most advanced design (Fig. 64). It was intended as a new capital for Libya but has now become a modern university town. The house of parliament is to be the state library. Not far from the earliest Zauia of the Senoussi, about three kilometres west of the town, not only a royal palace but also an Islamic university have been erected, the latter to enjoy the same status as the El Azhar University in Cairo.

It is in the towns where the small class of educated Arabs, civil servants and business people with European attitudes, clothes and modus vivendi can be met. Here too, live those few people who work in factories and other establishments, and here are the schools for children and places of further education for adults.

Schoolchildren seem to be already fully or at least partly dressed in a European fashion; they wear clean school uniforms and receive a meal at school. Attendance is compulsory for boys but voluntary for girls. Although there are a few female students at Benghazi University, they still veil their faces save for one eye, when they enter the street — just like the majority of girls and women do.

"Even the pupils (13—18 years old) of the teacher training college in Benghazi we saw entering the college building with veiled faces. During lessons they took off their veils. They appeared to be pretty, young girls with modern coiffures and European dresses but did not permit photographs except from behind. When they leave the school they veil their faces once more with a black veil or the traditional barrakan" (L. Richter).

So there is already a fair number of girls attending schools in the towns and training after that as teachers or nurses. On completion of their education, often already at the age of 14, many of them marry. This means that the decision on whether they are permitted to take up employment rests with their husband.

In the towns there are also evening schools for the adults who can be seen eagerly learning the art of reading and writing. Thus a gradual loosening of ties to the rigid way of life in the villages comes about. Knowledge is spreading and the primitive conditions of life among the poorer classes and the immigrants is starting to improve.

For the time being this gradual change can only be noticed in the towns. Immediately outside the town the power of tradition through family, village community and religious elements governs the life of the rural population, make more difficult and slow down all progress. Only in those places where larger numbers of elementary schools were established in recent years, the beginning of some relaxation may be felt.

C. Health Services and Environmental Sanitation

I. Medical Facilities

1. Tripolitania

Prior to the occupation of Libya by the Italians, rudimentary measures of hygiene were few and confined to the city of Tripoli with 30,000 inhabitants (1910) and some larger places which had Turkish garrisons. In Tripoli the lanes of the old, narrow part of the town were unpaved, scarcely any provisions for gullies had been made and surface water accumulated in swamps together with the liquid manure flowing out of the houses. Wells were situated in the courtyards of these houses. As the population density rose, the water did not suffice and covered cisterns were built in various places, collecting the water from roofs and streets. Cisterns and wells, and thus also of the groundwater-table which reaches a depth of 5—10 m. below the surface and is salty in places, were unprotected from sewage seeping into them. Every year a number of mosquitoes, flies and disease germs developed in the swamps and cisterns.

Consequently cholera broke out almost every year, sometimes also plague. Malaria and typhus were frequent endemic diseases in the city. Since 1670, the Franciscans had made arrangements for the treatment of sick

people in their monastery. In the event of epidemics they put up other infirmaries in the monastery and in the cholera epidemic in 1910 even a ward for Europeans. Only in the final years of their rule did the Turks begin to install sanitary devices. The Italians did not, therefore, find many on their arrival in 1911. At the port there was the Ufficio di Sanità Marittima (Control of ships and Mecca pilgrims) with a laboratory for food tests; in the town there was the Ospedale Civile Municipale with divisions for surgery, internal diseases and eye diseases, without, however, latrines or any other sanitary installations. Finally, there was the adequate military hospital under the direction of a Turkish military doctor. Here bacteriological examinations and vaccinations were also carried out. In 1910 a cholera hospital consisting of five timber barracks was established near the Bab el Gedid. People with infectious diseases were not as a rule kept in isolation but treated at home which often consisted of a single room accommodating the entire family. There were six pharmacies in the city, the most important of which was the city pharmacy at the fort, only demolished after the last war.

Having achieved the occupation of Libya, the Italians were faced with the fight against infectious diseases, the sanitation of towns and larger localities as well as the erection of modern hospitals for the population as their most urgent tasks. Civil and military organisations worked together over these matters. Traffic from the interior to Tripoli was controlled, medical centres established at Suk el Giuma and at Gargaresh and about 7,000 people were examined, about 50 per cent. of whom showed symptoms of disease, especially of trachoma, grind (Tinea favosa), syphilis and other infectious diseases. Already from the autumn of 1912 onward no more serious epidemic outbreaks occurred. The sanitary conditions of the city were thoroughly improved, a daily road-cleaning service introduced, gullies constructed and pits which overflowed were cleaned out.

a) Hospitals

Only after the war, in 1922, the systematic construction of the new city of Tripoli commenced and with it that of a public health service; later on it was taken over and extended by the Libyan state. In the course of this programme, the first one to be built was the Ospedale Coloniale, the present government hospital, on the southern fringe of the city. It is designed as several pavilions. There are several wards, divided according to the sexes, operating theatres, a bacteriological laboratory, a ward for children and an isolation ward with 100 beds for contagious tuberculosis. In Hammanyi near Wadi Megenin and the sea, a hospital with seven pavilions for infectious diseases was built as well as a mental hospital with a psychiatric ward in Feshlun, a T. B. sanitorium in Busetta and a home for lepers. There are besides, a few private hospitals and the British military hospital which was handed over to the Libyan Social Insurance (I. N. A. S.) early in 1966.

In the province of Tripolitania (1.03 million inhabitants 1964) too, the Italians established hospitals. The first ones were set up in small administrative centres. Today the province, together with the city of Tripoli (6) has 16 hospitals with more than 2,500 beds at its disposal (see table). Each hospital usually owns several ambulance cars which often have to cover long distances so that still more are needed.

b) Out-Patient Clinics and Dispensaries

Dispensaries which are looked after by doctors, were also set up for the population. Today (1964) the municipality of Tripoli runs 18 out-patient clinics and dispensaries, 8 of which are manned by full-time doctors, the remaining ones by auxiliary medical staff. They are, however, visited by a doctor everyday. In addition there are specialist dispensaries: one for eye diseases, one for venereal diseases, one run by Franciscan nuns and one mother and child health centre. These dispensaries are well equipped, amply supplied with medicaments and generally have a few beds.

The number of dispensaries in the province has increased to 129 (Tripoli 18), some of which are mother and child health centres (4 in Tripoli). Here too, only a few are manned by doctors. A doctor visits the dispensaries only on certain days. Should urgent cases arrive, he or the hospital to which it is attached, is informed. In 1964 a mobile clinic under the direction of the German physician Dr. MEINCK travelled across the country, looking after settlements rarely visited by doctors and carrying out vaccinations.

c) Doctors

There are certain difficulties in filling vacancies for doctors in hospitals. In 1964 there were 275 doctors working in Tripolitania, 88 in Cyrenaica and 23 in the Fezzan. Together with the doctors employed in the ministries there was a total of 386 doctors in the country which has a population of 1,559,300; only 20 of them were Libyans. However, the number of local doctors increases every year. A fair number (more than 50) is training in Europe, the U.S.A. and at the American University in Beirut. The majority of the foreign doctors comes from Italy (125), joined by large numbers from Jugoslavia and Spain in recent times as well as some Greeks, English, French and Chinese. The number of German doctors is regrettably low (4), but those in the field have contributed greatly to the respect their country enjoys. In 1965 a further 300 Spanish, Jugoslav and nationalist-Chinese doctors have taken up posts in Libya.

d) Nursing Staff

There are still very few male and female nurses available; training schools have now been set up in Tripolitania for nurses and other female staff only, in Benghazi for male hospital orderlies where very recently the training of medical-technical assistants too, has been started (Health Training Institute). In 1964, there were 174 nurses in Tripolitania, 80 in Cyrenaica, 4 in the Fezzan. Their numbers are gradually increasing although there is the risk that female nurses get married and are then no longer permitted to work as this would damage the reputation of the family. There are 196 non-Libyan nurses and orderlies.

e) Midwives

In order to get a permanent staff of midwives for the population, the German gynaecologist Professor FÖLLMER started a midwifery training centre with a branch

Table I. *Medical Facilities in Tripolitania*

a) Hospitals:

		Beds	
Tripoli:	Government hospital		
(6)	(with all wards)	1,460	
	Hospital for Infectious Diseases		
	Hospital and Home for Lepers	50 + 20	
	Busetta T.B. Sanitorium	150	
	Feshlun Mental Hospital with psychiatric ward		
	Government Accident Hospital	100	
	Government Hospital for cases of contagious T.B.	100	
	Libyan Military Hospital		
	British Military Hospital (handed over to the I.N.A.S. — National Social Insurance, in 1966)		
	Several private hospitals (among which there is one maternity hospital of the I.N.A.S.)		
	Another big hospital under construction (1966)		
Tripolitania:			
(10)	Zawia	140	
	Zuara	80	
	Garian	60	
	Jefren	110	(140)
	Nalut	?	
	Ghadames	20	
	Beni Ulid	40	
	Misurata	410	
	Gargaresh (new clinic for nervous diseases)	510	
	Zliten	?	
	Homs — under construction		
	Sirte — under construction		
	Jado — clinic in Fayasla prospected		

2. Dispensaries (numbers):

Municipality of Tripoli 18+4 (3 of which are dispensaries for T.B.)

Mudiriah:			
(= administrative district)	Suk el Giuma	4	
	Tadjura	6	
	Ben Gashir	6	
	Azizia	3	
	Zawia	6	(1× T.B.)
	Zanzur	6	
	Bianchi	4	
	Sorman	2	
	Sabrata	5	
	Zuara	6	(1× T.B.)
	Nalut	10	
	Ghadames	4	
	Garian	9	(1× T.B.)
	Jefren	8	(1× T.B.)
	Jado	9	
	Misda	5	
	Beni Ulid	1	
	Tarhuna	6	(1× T.B.)
	Cussabat	3	
	Homs	7	(1× T.B.)
	Misurata	9	(1× T.B.)
	Zliten	6	
	Sirte	4	

Further Centres of Public Health have been projected for the Jado area in Slamat and Sheqshuq, and near Gadames in Derj.

Note: The table gives the figures for 1964.

in Benghazi which was intended to gradually take over from the "wise women" so far exclusively working in this field. An attempt is being made to teach these latter at very least the most elementary rules of hygiene during a two-month course. Town and country taken together, there are 43 fully-trained midwives registered, 5 in Cyrenaica, and 5 in the Fezzan (1964). A midwifery training centre with an attached clinic is being built in Tripoli (1966).

f) Pharmacies

Each hospital has a pharmacy. Most private pharmacies do not employ trained pharmacists. A centre for pharmaceutical items with a store is to be set up in Tripoli.

2. Cyrenaica

In Cyrenaica (451,469 inhabitants) conditions were similar to those in Tripolitania. Larger towns in particular suffered from the wars, especially the last one, in the course of which Cyrenaica changed hands on several occasions. Above all, Benghazi had been demolished by air-raids. Even today these scars are still to be seen on houses and empty spaces have been left where the debris has been removed. The water-main and sewers, put down during the Italian period had, of course, suffered.

a) Hospitals

Just as in Tripoli, the large hospital of the town of Benghazi laid out in pavilion style (500 beds) in the north of the town and founded as the Ospidale Coloniale, contains all its wards plus an out-patients' dispensary, organized under the main disease categories. In 1964, 22 nuns were working there as theatre nurses and as the operators of complicated apparatus (X-rays, physiotherapy, laboratories); they supervised kitchen and laundry and looked after the wards as nurses. They support the 40 doctors there. One hundred beds are available for people suffering from tuberculosis. In addition to this large hospital there is a much smaller town hospital. Here, too, a dispensary is run by hospital doctors (8) and nuns (10). There is then a small missionary hospital of the Adventists with 30 beds, run by two doctors and a staff from Palestina (Israel). In addition to these, Sharia Bagdad, es Sabri and Berka each have a dispensary with a full-time general practioner and there is a T. B.-Policlinic with three doctors, established by W. H. O.

The suburb of Berka in the south-east of the town is expanding rapidly. New blocks of houses are being built and as a high rate of population increase is anticipated, appropriate arrangements are being made now. A big new government hospital is under construction (500 beds), a gynaecological and paediatric hospital of the I. N. A. S. (National Social Insurance) is almost complete and a new T. B. hospital (140 beds) is being built in Guarsha (15 km. away from Berka). The Adventists are also busy building a new hospital (100 beds) on the road to Soluk, while the Libyan as well as the British Army possess their own hospitals in Berka.

In the province, Derna is now (1960) the only place so far with a large government hospital with ten doctors (since the middle of 1965, Chinese ones), under the di-

rection of a German physician (Dr. KLUG) and 420 beds, 140 of which are reserved for people suffering from T. B. As for specialist branches, eye diseases, children's diseases, midwifery, surgery and internal diseases are represented. There are dispensaries in the town, one staffed by a doctor and another, completed in January, 1965, but still lacking a doctor. The new hospital in Beida has not commenced operation yet, the hospital in Barce (el Merj) which formerly had 100 beds, was partly destroyed by the earthquake in 1963. At present (1964) there is only a barrack with one doctor available to patients, together with a small ward run by three nuns. America presented Libya with a new hospital built in Tobruk; there are three doctors, on a Palestinian and two Egyptians. A hospital for T. B. patients with a pulmonary surgery section was built by the B. D. S. A. (British Development Service Association) in Cyrene. Four doctors and nurses from Jugoslavia are employed here. Otherwise there are only small hospitals in Messa and Ajedabya, a surgical specialist working in the latter. Kufra has a large dispensary with 10—20 beds and a doctor; a similar one is under construction at Aujila and there are plans for the erection of a dispensary at Jalo. M'said (Capuzzo) has been equipped with an isolation ward as it is a border town.

b) Dispensaries

Thanks particularly to British initiative, dispensaries were set up in almost every village of Cyrenaica and staffed by a medical orderly. In the Derna District for example, they are visited by doctors of the government hospital once a week on request. Ambulance cars are available to hospitals and even to the more remote oases. Long distances lead to a lot of wear and tear on cars so that their usefulness soon lessens. Helicopters are available in serious cases.

c) Doctors

There are 47 doctors in the city of Benghazi, 22 in the surrounding region, 19 in the two other provinces.

Government and privately employed dentists number 4 or 5 in Benghazi; Beida, Derna and Tobruk have one each.

Table II. *Medical Facilities in Cyrenaica*

a) Hospitals:

		Beds	Doctors	
1. Benghazi Province:				
City and Region:	Government Hospital	400 + 100 T.B.	40	
	Municipal Hospital	40	8	
	Adventist Mission Hospital	30	2	
	British Military Hospital	60	3—4	
Berka:	New government hospital, Berka	c. 500		under construction
	Womens' and Childrens Hospital (I.N.A.S.) Berka			under construction
	New Adventist Mission Hospital in Berka	c. 100		under construction
	Libyan Army Hospital, Berka	?	?	
	Guarsha T.B. hospital (15 km. from Berka)	140	1	
Benghazi:	Ajedabya hospital	c. 100	1	
	1 larger dispensary at el Abiar	20		
	1 larger dispensary at Augila	10	1	
	larger dispensary at Jalo	planned		planned
	larger dispensary at Kufra (el Jauf)	10—20	1	
2. Jebel Akhdar Province:				
Barce:	(el Merj) destroyed by earthquake	100	1 barrack 1 doctor Dispensary and 3 nuns	(now 1964)
	former small sanatorium for pulmonary diseases	100		
	Cyrene, (Shahat) T.B. hospital with pulmonary survery unit	150	4	
	Beida, new hospital not yet opened in 1965	?		
	Messa	90	2	
3. Derna Province:				
Derna Town:	Government Hospital	280 + 140 T.B.		
	Hospital prospected			
	M'said (Capuzzo) larger dispensary	—		isolation ward under construction (border post)
Tobruk:	new hospital erected by Americans	120	3	
	hospital in old garrison buildings	150		
	new hospital prospected	122		
Dispensaries:				
Benghazi:	4 staffed by doctors; almost every village has a dispensary; T.B. treatment in Ajedabya, Barce, Beida, Derna, Tobruk		Note: Number of doctors in 1964 incomplete.	

d) Midwives

See above. In Derna district there are 3 in Derna, and 2 in Gubba. Having undergone a two-month course at the midwives' training centre in Benghazi they are allowed to continue in their jobs for the time being. Nursing sisters train about 20 of them every year.

e) Pharmacies

A pharmacy is attached to each hospital. There are 14 private pharmacies in Benghazi, four of which are run by trained pharmacists. There are two in Derna without pharmacists and one each in Tobruk, Beida and Ajedabya.

3. Fezzan

The Fezzan (78,714 inhabitants) was the last one to be opened up in the sanitary sense. Although there were already small ambulatories (out-patient departments) in places with garrisons even in the Italian period where the civilian population could be treated as well by the military doctors, the first hospital was only established at the time of the French occupation. It is situated in Dar el Bei, the new capital and administrative town of the Fezzan, between the three Sebha oases. The large modern hospital is under the care of six French doctors; it contains 100 beds and various special wards, particularly for T. B. patients (30 beds), as well as an operating theatre, laboratory and pharmacy. A small T. B. sanatorium was added at a later stage (30 beds).

Smaller hospitals, which developed from Italian military out-patient departments with only a few beds (2—4), are situated nowadays at Hun, Brak and Ghat. A new, well-equipped hospital with 20 beds was built by the Americans in Murzuq and completed in 1962. Until now a doctor (specialist for eye diseases) has worked in a former sick-quarter (6 beds). As a specialist he operated particularly on trachoma cases. The patients lay on their beds and their wives, if they accompanied them, on the floor in front of the beds. On completion of the new hospital a second doctor was expected. The new building will contain an operating-theatre, a small delivery room, x-ray and medico-physical facilities, laboratory and pharmacy as well as the necessary spaciously designed auxiliary rooms (kitchen, laundry, stores) in a separate building where patients could also be accomodated should the need arise. Wards for men and women are separated by rooms for medical treatment. Opposite the hospital there are the new private quarters for doctors, probably by now accommodating two of them.

Hospitals tend to supervise a number of dispensaries, which are generally run by trained nurses. In 1962, 10 dispensaries were attached to Murzuq hospital (to give an example), which were visited by a doctor on request. Thus the district he was in charge of extended as far as the Tesaua in the west, Tmessa in the east and Tegerhi in the south. There are about 30 dispensaries in the whole of the Fezzan (1964).

Table III. *Medical Facilities in Fezzan*

Hospitals (1964):

	Beds	Doctors	
Sebha	108	6	(T.B. ward with 30 beds)
Brak	20	—	
Murzuq	20 *)	2	*) maternity and surgery
	plus 20		*) infectious diseases
Ghat	20	—	
Hon	20		
Total of doctors (1964):		23	
Trained nursing staff (1960):		15	
Untrained nursing staff (1960):		59	
Trained midwives (1964):		4	
Trained pharmacists (1962):		1	

4. Plans for Further Development of Public Health Services and Health Education

The Libyan Ministry of Health together with the W.H.O. prepared a 5-year plan for public health which aims at the further development of the present foundations of the public health services. This 5-year plan started with the financial year 1963/64.

Occupying the first place is the new construction of hospitals and the enlargement and improvement of older ones by the establishment of new specialist wards to be equipped with modern apparatus and instruments. The number of existing beds (3,657) is to be increased to 5,800, so that about 3.5 beds will be available for every 1,000 inhabitants.

As a separate service besides the hospitals, the anti-tuberculosis service in Tripoli and the tuberculosis centre in Benghazi deserve mention; the personnel necessary to carry out anti-tuberculosis campaigns are trained there and from them mobile teams are sent out to identify, treat and control the disease. A number of dispensaries is available to this service. Mobile units, too, carry out the fight against malaria and bilharziasis. The control of trachoma, directed by the Epidemiology Centre for Trachoma provides for the safeguarding of health and the treatment by mobile tented groups (medical camps) which attend to the nomads. Teachers are trained to such a degree that they are able to supervise pupils and to demonstrate the usefulness of hygiene as well as the dangers of eye diseases.

In order to attend to health in schools, Tripoli and Benghazi are each to have a health centre established. School visitations will pay attention to cleanliness inside and outside the schools, to the provision of healthy rooms for classes and will support teachers so that infectious diseases can be treated as soon as the first symptoms are discernible. Mobile dental clinics will make regular rounds to schools in the countryside. School-meals consisting of milk, bread, dates and other foodstuffs, are to be extended.

One of the most important schemes is the establishment of health centres according to the density of the population. So far 61 of these are planned. They are intended primarily for treatment of ambulatory cases; they contain at least 13 rooms, one of which is set aside for the two doctors and a midwife. In other words, they are ordinary poli-clinics with ample equipment and their own means of transport. Three dispensaries are attached to and medically attended by each health centre (thus linking a total of 183 dispensaries with a medical centre). These dispensaries ought also to be established in their own buildings with at least three rooms for medical attention. "Clinomobiles" are to reach the non-sedentary population.

Much stress is laid on the development of a maternal and child health service. Centres for training and instruction are located in Suk el Juma near Tripoli and in Benghazi (maternal and child health schools and demonstration centres). Pupils are trained as nurses; midwives are also trained here. At a later stage they will take over the service in the main maternal and child health centres. These in turn are attached to the health centres. The main maternal and child health centres have branches, the smaller sub-centres (Table XI). Wherever possible these centres are to be staffed by female nurses and doctors only.

As experience at the first maternal and child health centres showed, the first steps will have to be the overcoming of the women's shyness of the health service. Once convinced of the usefulness of the arrangement, ever increasing numbers of women come along. They learn how to treat their babies properly, which kind of food to give them after weaning and how to prepare this food correctly; their children are examined and treated wherever necessary. Women are convinced that vaccinations do not harm their children but rather protect them. Nurses teach them the most rudimentary hygiene requirements, interest them in cleanliness, attend to pregnant women even in their homes and make sure that they are better nourished.

Another project of the 5-year health plan is a building programme to replace the slums. About 4,000 to 5,000 homes are planned, 3,000 of which are to be in Tripolitania and 1,500 in Cyrenaica.

Quarantine wards are to be established in the ports of Tripoli and Benghazi, at Idris Airport and in Benenina as well as at the frontier near Zuara and M'said.

Control of foodstuffs [bakers, butchers (i. e. slaughterhouses) and restaurants] will be extended.

II. Drinking-water Supply

1. Tripolitania

a) City of Tripoli

At first only the upper groundwater-level (6—10 m.) of the groundwater occurrences in and around Tripoli had been used. It had been opened up by wells serving domestic needs and in the oases by dalus (goatskin bag attached to a framework over a well) for irrigation purposes. The amount of water obtained was perfectly adequate. But things changed when the Italians built a new town and some of the dalus in the vicinity were replaced by pumps. In order to obtain sufficient water to supply the city, the construction of a purification plant had already been considered, but after carrying out numerous drillings, the Italians found yielding water supplies near Bu Meliana, which were further supplemented by discoveries near Hamadi. From here a supply network to the town was built. Now some of the damaged or old pipes have already been replaced by new ones of a diameter twice that of the originals. This network supplies the whole town as far as the Porta Tajura and Mellaha and in the west far into the old part of the town where a larger storage-tank was placed above the cliff in 1962. At the Porta Ain Zara a small waterworks has been built; the one at Bu Meliana has been considerably enlarged and modernized by two pump installations in 1964/65.

Only small parts of the city are still unconnected to the general water supply, such as the newly developed area of Giorgimpopuli on the coast west of the city where water is obtained for the time being (1964) from private companies. These, it is hoped, will eventually be bought out and linked with the general supply network. A greater problem for the city administration, however, is the area south of the old part of the city, which is divided into small plots with completely unplanned building. Many of the poorer owners cannot afford the connection to the water mains and continue to obtain their water from wells (5—6 m. deep) in their courtyards. They usually lack a connection with the sewage system as well. From their own cess-pool or that of the neighbour nearby, contaminated sewage, penetrates the groundwater and thus their wells.

The great quantity of water used for irrigation in the hinterland (1960: 103 million cubic metres/year) which is extracted from the groundwater, threatens to jeopardise the city water supply. Increased consumption must be anticipated in the course of the coming years and this means that pumping will increase as well, causing in turn incursions of salt-water from the sea. In Suk el Juma the water has already become brackish.

The Americans also use wells fed by the upper groundwater-level for the supply of their Wheelus Field air base nearby. However, not more than a limited amount of water can be pumped out here as the clay stratum between both the quaternary horizons varies in thickness; it has fractured at several points and has thus allowed salt-water to penetrate. The actual hole was filled with concrete but afterwards the amount of water pumped had to be severely reduced. In addition a small plant for the desalinization of sea-water was set up by the Americans.

b) Tripolitania excluding the City

Gradually the smaller towns of Tripolitania, not yet enjoying piped water supplies, are also being supplied with a water-main. Simultaneously pipes for sewage are to be installed. For the lavatories of all houses it means a change to flush-toilets. Since seat-type closets are often badly soiled it would seem, in the author's view, that squatting-type closets with flushing devices might be preferable from the hygienic standpoint.

Water supplies in coastal towns pose some difficulties at times and single wells situated near the coast must not be over-exploited. Zawia for example, obtains good water from its immediate vicinity, but unfortunately even here a gradual lowering of the water is noticeable in the south as a result of over-demand by irrigation (see Bir Ghnem Project). Zuara, situated between sebkh and periodic salt lakes, suffers from a lack of water. The Italians had excavated galleries in the dune area in the vicinity of the settlement which collected water and led it to cisterns, which, together with the wells, provided about 100 cubic metres a day. Near Agelat at a depth beyond 500 m., strongly flowing, albeit saline, artesian water was drilled and could be used for irrigation; at present there are pipelines installed which lead to the south into the area beyond the sebkh where water of a satisfactory quality was found near Mensha, el Gamil and Regdalin.

In Homs wells provide good water from shallow depths whereas in Zliten at depths of 6—8 m. only salty water can be obtained, adequate for irrigation of the palm-trees but unsuitable for human consumption. In the vicinity of the settlement some farms have already been deserted because of the over-high salt content of the wells. Deep drilling did not result in the discovery of better quality water. Now the Wadi Caam supplies the settlement with drinking water. Zliten as well as Misurata were provided for by small plants for the purification of sea-water. These plants are not over-popular among the inhabitants because the drinking of this water is said to cause mothers to bear only girls and no sons. Apart from that, Misurata is supplied by some wadis from the hinterland which come from the south-eastern slope of the Jebel where satisfactory water was found, as in the cases of Tamina (Crispi) and Kararim (Gioda), which is in addition supplemented by artesian water which is adequate for irrigation and was drilled in some places. The incursions of salt-water into wells following the use of pumps forced the suspension of irrigation near Misurata marina. The vicinity of Sirte also provided only a little sweet water (part of which comes out of the dunes), but it is just about sufficient for men and their cattle.

The *settlements of the Tripolitanian Jebel* generally enjoy good water, which in the more humid east appears at times in the form of springs. Tarhuna, for example, has one of the older (Italian) wells in the town, which yields 150 cubic metres per hours from a depth of 42 m., and near the source of the Wadi Ramla a spring with flowing water emerges, periodically falling down a scarp as a 4 m. high waterfall only 5 km. north-north-east of Tarhuna.

The water supply of Gharian is more difficult. A few small springs, particularly the Ain Turk (100 cubic metres/day) and the Ain Tobi (15 cubic metres/day) fill reservoirs for the municipal water supply. Drillings in the vicinity did not produce a satisfactory outcome. Plenty of water was recently found in the Wadi Gan; it is planned to pump it 200 m. up to the town. Jefren is supplied by the waters of the Rumia springs south of the locality which are pumped into storage-tanks. Similarly Jado and Nalut pump their water up to the level of the settlement from the valleys which run in a northerly direction to the Jefara where the groundwater-table reaches the surface. Cisterns and wells, large at times and equipped with dirt traps, collect and store rainwater and a little water from springs, thus supplying the population and their cattle at Zintan, Cabao and Tegrinna and their environs. There is, however, not sufficient water available to permit irrigation.

2. Cyrenaica

Due to the large deposits of limestone in Cyrenaica only in some places and at greater depths where marls and clays occur do the more extensive formations of groundwater with satisfactory water occur. In the mid-Tertiary limestones and Cretaceous chalks a karst water system developed. Already in ancient times this made water supplies difficult for a sedentary population. Towns only developed where karst springs came to the surface at not too great a distance, as at Cyrene (Apollo's Spring — Ain Shahat), at Apollonia, Derna, Tolmeta-Ptolemaide (8 km. long pipeline to a large cistern with a capacity of 6,500 cubic metres) or where potable groundwater was at hand as at Berenice-Benghazi, Tocra and Barce-Merj. Thanks to favourable precipitation the rural population of the Jebel Akhdar was able to store water in cisterns, large numbers of which have been rediscovered.

Over the last few years, a systematic search for water was carried out with a great number of test drillings, as, due to the continuous increase of the population, especially in the towns and larger settlements, difficulties over water supplies occured again and again. Benghazi (136,641 inhabitants) which had become a populous town, suffered most from the lack of water. The old town had been adequately served by hand-drawn wells reaching to depth of 15—20 m. which did not supply much water and even that in the main slightly brackish water. Wells the Italians operated with power pumps soon produced water of inferior quality as salt-water infiltrated. Because of the salt content, wells and pipelines built by the Italians soon became useless. Only a few years ago, water-carts — i. e. barrels with a tap on a pair of wheels — rolled through the town selling good drinking water. Near Benghazi experimental wells down to depths of 1,000 m. yielded scarcely any water. Only in the neighbourhood of Benina (in the east) several wells, 75 m. deep, with good quality water were found and these now supply the town. At certain borings between Benina and the sea the danger of incursions of salt-water is imminent. In Guarsha in the south of the town, which used to be a good gardening area, many wells are now permanently or at least temporarily dry. Drillings only produced little water or water which was salty. Near Er Regima in the east of Benina, however, ample good water was found at depths of 300 m. Unfortunately the water of the Zeiana well, which comes to the surface on the edge of a lagoon in the north of the town, is slightly brackish and also the water of the small wells of Coefia and Tocra is of medium quality, so that it cannot be considered for the supply of the town. It is believed that a sub-surface karst river from the mountains feeds these springs and a number of small collapsed dolines. It had been considered that the water supplies of the town could be supplemented by water from the Debussia Well in the east of the Jebel, the water found near Er Regima, but the project has been postponed for the time being.

The eastern and north-eastern edge of the *Jebel Akhdar* is richer in water. Here karst wells came to the surface in some of the wadis which have been cut deeply into the first and in parts also into the second scarp. Some of those with an ample flow of water have been opened up recently. The Debussia Well in the Wadi Debussia which flows into the Wadi Latrun deserves special mention. Through the exit of the well, now lined and prepared for the drawing of water, a road 7 km. deep into the mountains leads to a small lake. At the start the water is led through surface pipelines, British-made as at el Beida. The arrangement which was to go as far as Barce, no longer complies with the demands since all the villages in the vicinity have been connected with the network subsequently and are supplied by it as well. The firm of Mannesmann was therefore given the contract to build a second pipeline via Beida and Messa to Barce. Long stretches of pipes have been laid in a ditch, which over some sections had already been

dug by the Italians along the northern road to Derna. The Italians intended to lead water from the Shahat well to Barce. Since the well produces only a little water it is not suitable for a long-range conduit. The Debussia well is to provide 27 million litres (6 million gallons) of water for the west each day by pumping. Nine million litres (2 million gallons) were assigned to Beida, nine million to Barce and nine million to neighbouring villages as distant as 20 km. away from the pipeline. Madalena and Oberdan are to receive water for irrigation purposes and in Fazura (Baracca), for example, each individual farm is to be supplied. It is, however, feared that the smaller springs in the lower Wadi Latrun and the cascades (50 m.) in the Bay of Hillal will soon lose their water (Fig. 22).

So far Beida was supplied by some small wells in the vicinity. Barce, too, only received water from some wells (187 m.) and cisterns, which was just adequate for cattle and domestic use.

Since the ancient Tolmeta Spring was rediscovered, there is no longer any need to lead water there from Barce.

The water of the Ain Mara (6 springs), 15 km. east of Gubba, had been intended as the source of supply for the surrounding villages and farms, but the nomads, who own the springs, objected. Thus for the time being the water continues to be used solely for the irrigation of the valley and for the needs of domestic animals. Surplus water runs away unused. The linings of the springs, which date back to the Italian period, are still there but the large pumping plant has been destroyed. It is hoped, however, that as the springs are assuredly sufficient for both parties, negotiations with the nomadic tribes will eventually lead to a better use of the water.

The town of *Derna* is supplied by the Bu Mansur spring from the Wadi Derna (22,634 cubic metres/day). A pipeline about 12 km. long takes it into the town. The surplus, tumbling down the Derna Waterfall (20 m.) is collected in trenches and used for irrigating the gardens of the town. Although there is ample water coming to the town from the spring, supplies run short at times because the inhabitants' laziness leads them to use drinking water for irrigation purposes. Six kilometres below the Mansur Spring, lies the Ain el Bilad which is connected with Tobruk by a 178 km.-long surface pipeline (supply: 10,185 cubic metres/day).

In some wadis, as for example near Gubba, good but scarce water was found. Martuba also has a well and Tmimi receives water, which is good to slightly brackish in quality, by captation (collecting galleries) from neighbouring wadis. Test borings in the vicinity of the place have established the existence of good water. The Wadi Um er Rezzem has good water from wells near the surface. Nomads use some of it to irrigate their fields. Slonta on the southern slope has a small spring in the vicinity, Mechili some wells and cisterns. Everywhere in the Jebel attempts are being made to revive the old, infilled cisterns. For a reward of Lib. £ 2 farmers clean them out so that they can serve as additional suppliers of water.

Tobruk received its domestic water from collecting galleries in two wadis in the west and from water dealers before the water pipeline reached the town in 1962. For the British garrison water was even shipped in tankers from Bardia in Cyprus. Test drillings between Tobruk and el Adem proved the futility of further tests. Since the town is expanding and as the terminus of an oil pipeline is intended to become an oil port, a sea-water purification plant will have to be built in addition. Further to the east modest wells with satisfactory water are only found near Bardia and towards the Egyptian frontier.

South of the Jebel Akhdar water conditions generally worsen. Ajidabia, the wells of which do not provide water of particularly good quality, is supplied with water from the vicinity of Zuetina (coast) and Sidi Sultan for its network. The oil port Marsa el Brega, which is developing fast, was supplied with a sea-water purification plant. Marada has some artesian water as the scattered wells all contain salt; the Jalo oases have plenty of similar water but this can only be used for irrigation as the soil is sandy. The best water in the entire complex of oases comes from the Buttafal Well. It is obtained at a depth of one metre and taken to El Ergh (Jalo) for sale.

3. Fezzan

It can be said that apart from a few places, the whole Fezzan has sufficient satisfactory water for the supply of the population and the irrigation of their gardens. Test drillings have shown that there is still plenty of artesian water to be gained from Devonian strata.

Dar el Bei, the new town in Sebha, was the first to be supplied with a water system. El Gedid, the old part of the town, as well as Gorda, a small settlement in an oasis and Hadjara with the Elena (Leclerc) fort, airport and settlement are also connected with the network. The water lies close to the surface (down to 12 m.); north of el Gedid it comes to the surface in meanly flowing springs.

Test drillings located additional water in the Nubian sandstone. Although the water is somewhat salty at times, it is sufficient for the supply of the population and for irrigation purposes. The gardens often become salinized, however, probably as a result of the inadequate discharge. Water conditions in the entire Buanis are similar. They are sufficient for irrigation with dalus and at times continue so even if small pumps are employed.

Of all the large wadis, the 150 km.-long *Wadi Shati* appears to be the most fortunate. There are numerous artesian wells along the northern edge, all of relatively good quality water — the Italians were careful with the opening of new wells. After the French occupation, the L.A.J.S. and private people began to drill new wells especially around Brak with the result that much of the water flowed away unused, the soil became salinized and water penetrated the walls of the village houses from beneath. Some wells, which were in higher positions and had hitherto irrigated small oases, ceased flowing. It had apparently been the intention to open up large stretches of so far unused country. It was a great shock to see white salt plains and the swamped and salinized lower wadi courses in 1962. With the exception of nine wells which are to continue providing water, the government has now taken the wells under its control in the hope that desalinization, by the laying out of irrigated rice-fields by experts, might succeed. Some success is said to have been achieved already (Fig. 7).

The Wadi Adjal has sufficient water from wells; before that the oases were irrigated by the construction of foggeras. When they were carrying out test drilling down to depths of 350 m., the French broke through several aquifers. In the Hofra good water lies adequately high; at Traghen there are three small springs (small lakes) and also the Wadi Hekma (Gatrun) does not suffer from lack of water (wells).

In the *Jofra*, a faulted basin in the north of the Jebel es Sauda, the Italians drilled through to warm, mineral-bearing water, which can be used for irrigation, from depths of 446 m. near Hun. The same horizon has been discovered in Waddan where it is deeper and contains more salt. Near Ain el Hamman, north of Socna, a well with tolerably salty water was opened up (400 m. deep) and recently (1964) another one with good fresh water (200 m. deep), two kilometres south of Socna. This latter is to provide Socna township and to be led to Hun. If no good water is found near Waddan, the pipeline is to be extended to that place.

Until now the water gained from the horizon just below the surface is only poor in quantity and quality. At Bir Washka, 40 km. distant from Socna in the Jebel es Sauda, there had always been an isolated well of fresh water (1933), probably on the same fault. Now a palm-grove with gardens has been created there. Zella, further to the east, has few wells with good water and is also said to have some foggaras for irrigation purposes.

III. Sewage and Refuse Disposal

1. Tripolitania

a) City of Tripoli

Together with the consolidation and asphalting of the roads, the Italians introduced the clearance and removal of refuse. Nowadays road-sweepers with wheeled bins go through the streets twice daily, sweeping together the rubbish and taking it to collecting points. It is burned outside the town or used to raise terrain; at present (1964/65) a section of the lagoon in front of the cliff of the old part of the city is being raised behind the cliffs.

The Italians led their sewers into the new port and into the sea west of the port. Some of them are antiquated or have been damaged by bombs so that sewage could seep into the groundwater and some probably still does in places not yet located. In 1964, certain stretches of piping were shifted or replaced between the old part of the city and the port. When, after superficial clearing, the gates are opened, swarms of seagulls and fish can be observed taking over the further job of clearance. Unfortunately suspended particles floating around west of the port are carried by the current to the public baths; moreover, the water there is polluted by sewage discharged from local closets into the sea. The planned improvement of the baths will probably overcome these abuses. A plan for the sewage disposal provides for a reversal of the present network and final discharge on sewage fields near Castel Verde which are then to be used for vegetable cultivation. The sand and dune-fields in the south of the city are well suited for this. Basins for the clearance of the water and pump works are under construction. Pits possibly effecting the groundwater as well as septic tanks generally serving several houses as is the case in Giorgimpopuli and periodically needing clearance, are to disappear.

b) Tripolitania excluding the City

Sewage in villages and larger settlements until now lacking a central piped sewage system has been collected in cemented pits or in several round pits (Khazan Tahlil) placed next to one another, the sides of which are made of dry stone walling. They are constructed for individual houses or for groups of houses. The water gradually seeps into the ground, the residue either being removed from time to time and the pit cleaned, or the dry stone walls just abandoned when full and new ones built next to them. For the time being modern septic tanks are generally installed only for public buildings and the police.

Isolated farms as well as houses in oases, mostly have a latrine in a shack behind the house. The pits are open, shaped like ditches and periodically receive a cover of earth. There is a plank lying across them, on to which one can step, or just a hole in the corner of the ground. These pits, as well, stay put when filled up. After 4—6 years the hardened dung is taken out and used on the fields. On uneven terrain the liquid manure often flows out of the house across the yard to the road, finally losing its way in the soil.

Cave dwellings near Garian-Tigrinna and others have their latrines in a narrow room accessible from the courtyard only. Near Zintan it was noticed that apparently not all the houses and caves had latrines, but used deserted, collapsed cave dwellings and their trench-like entrances as well as the open countryside instead.

2. Cyrenaica

Refuse collection in the towns is similar to that in Tripoli. In Benghazi part of the refuse, together with barrels full of faeces is tipped over a ramp into the sea at a point in the north of the town. The arrangement in other locations is similar, for example in Tobruk, where refuse and waste are thrown into the sea over the 10 m. high cliffs in the north of the town. Having passed through the crude sewage pits, even in Benghazi some of the sewage waters are still led into the sea and into the port. As parts of the di Punta and Giuliana sebkh are being filled-in, waste material is also being used for this. In the city of Benghazi the entire sewage system is to be co-ordinated and to be piped to sewage fields near Guarsha. Extensive grounds are available here and are eventually to provide the town with vegetables.

In Beida septic tanks, emptied by the town authorities, still make do for groups of several houses. A piped system is planned to take away the cleared sewage waters to the el Caf wadi as a receiving water. Modern canalisation is also planned for Derna where liquid manure is at present still permitted to be pumped from pits straight into the sea. Little attention is paid to the houses and huts of the poor who live in the heights beyond the el Bilad township. Most of them are squatters living on government land without a water, electricity and sewage system. Liquid manure flows from these dwellings into the lanes, then freely downhill across the limestone slopes and into the irrigation channels and at times along the water pipes which lie close to the sur-

face. Thus worm infestation among the population is high. Just as Derna, Tobruk is also engaged in the construction of a sewage canalisation.

In the villages almost every house has its pit in a shack, the nomads preferring the open country. In the remaining oases the sewage question has not yet been tackled. Better houses have an enclosed closet over a pit which can be emptied; next to the huts and seribs there are pits enclosed by palm-leaf fences. Infants use the sandy floors of the huts, from which the excrement is later removed. In Zella there was a row of closets standing next to the school of the new village; these were, however, freely discharging to the rear so that liquid manure and faeces fell down the adjacent slope. At least, the children were trained to use the closets. Apart from pits, derelict houses, trenches and the open country are often still used in the oases.

3. Fezzan

In the Fezzan a modern sewage system is planned only for Sebha. Pumps are to move the sewage a distance of 5 km. to a cleaning plant north of the settlement where the sewage water are to be cleared and the water to be used for irrigation purposes and the deposited sediment for manuring. So far the septic tanks are there and require regular cleaning. Some of them do not seem to fulfil their purpose adequately, as for instance at the hotel, where a swamp of liquid manure and sewage had formed in 1962. Apart from this conditions are as described above. Much use is made of the open country. Thanks to the reduced humidity content of the air and the effect of the sun, the destruction of the faeces proceeds quickly so that there can be scarcely any development of insect eggs and other germs.

D. Disease Occurrences

I. Outbreaks of Quarantinable Diseases in Libya

1. Plague

Even during the last century the coastal towns of Libya suffered from the attacks af plague. They were mostly brought in from Egypt where there was an endemic focus in the Nile valley from whence plague spread epidemically. Derna was hit worst about 150 years ago when the population in 1816 decreased from 5,000 to 500 within the town boundaries as a result of the plague. The epidemic outbreak was mainly transmitted to humans by rat fleas.

During the years 1863—1912 Libya seems to have been free from plague. Despite close links with Alexandria, no plague was brought in during this period. After their occupation of the country, the Italians observed the first cases (up to 81 of them) in Tripoli in 1913; this increased by a further 12 in 1915, and by yet another 18 cases in 1918. After a short interval the disease returned in 1917/18. In 1919, 33 cases of plague were established as such, in 1920 there were 20 and in 1921 there were 43. As a result of the campaign against rats and rodents together with the supervision of grain mills, bakeries and the port, the city has in general not been further troubled since then.

In the *Tripolitanian hinterland* sporadic cases were reported some years ago, but on the whole it was the so-called rural form of the disease without the intervention of rats but rather of steppe rodents only, the fleas of which infected people.

Numbers of people struck by plague:

1924:	in Zanzur 18	1931:	in Agelat 20
1925:	in Tripoli 1	1933:	in Zanzur 8
1930:	in Zuara 2		in Hashan 3
	in Agelat 8		in Tarhuna 2
		1934:	in Suk el Juma 2

In 1940, some people were suspected as having died from bubonic plague in El Ugila near Suani ben Adem (south of Tripoli). The Cabila was isolated. There were a further six cases and then the disease died out. It had been brought in from Algeria.

In Cyrenaica the first cases of plague of the century occurred in 1913—1922; there were several scattered foci: in Benghazi in 1913, in Derna in 1913/14 and then moving from the coast to the interior from Apollonia to Cyrene and from Tolmeta to Barce. In 1917 it reached its climax in Benghazi with 1,449 deaths, in 1918 with 446 deaths, in 1921 with 54 and in 1922 with 6 deaths (RAGAZZI). Thanks to effective action by the Italians, only isolated cases occurred after that and these were mainly small rural epidemics between 1924 and 1929. Even if the plague can be considered as having ceased in Libya since 1940, this short review of the history of this epidemic outbreak demonstrates that the country must be taken as an area susceptible to plague and potentially vulnerable. The geomedically significant understanding points to the fact that the rodent population of Libya forms a reservoir which is most receptive to plague. From the east or from overseas, by sea or by land with caravans from Egypt, new imports may occur.

2. Smallpox

At first smallpox only occurred sporadically in Libya, but the improvement of traffic routes, growth of population and its concentration in larger settlements, helped to spread it with the result that small epidemics occurred. In Tripoli, for instance, there were 60 cases in 1921/2 and 77 cases in 1924/5. There was a serious outbreak in World War II which lasted from 1944 to 1948 with its peak in 1946/47, corresponding with the performance of the disease in Egypt. Systematic vaccination finally overcame the disease. Since then there have been only isolated cases, ending in death where children were concerned; these have apparently recurred annually in recent years in the Socna-Hun-Waddan area.

Between 1926—1948 the following cases occurred in Tripoli:

1926	29 cases	1932	2 cases	1946	1,450 cases
1927	8 cases	1943	6 cases	1947	2,400 cases
1928	3 cases	1944	89 cases	1948	236 cases
1931	7 cases	1945	104 cases		

During the ensuing years no further cases have been registered.

3. Typhus

Epidemic typhus, the germ of which, Rickettsia prowazeki, is transmitted by body lice (as well as by rickettsia-bearing dust), seems to scarcely occur in Libya now since the D.D.T. campaign against body lice was strongly promoted in recent years. I was myself able to see how teachers in schools in the oases dusted D.D.T. powder under the shirts of their schoolboys and I can tell from experience that in spite of close contact with natives I caught no lice on both my last journeys in Libya in 1962/63 and 1964/65, whereas I had never failed to attract them when travelling on previous occasions. *Endemic typhus,* transmitted by rodent fleas takes a much milder course with humans than the classical typhus. As the course of the sickness is similar in influenza, typhoid and paratyphoid fever and others, an exact diagnosis is often made difficult.

Before the occupation of Libya by the Italians, there were serious epidemics of typhus fever. After 1921 there were only small outbreaks which were confined to western Libya: 8 cases in the city of Tripoli, 9 in the surrounding districts and a few in Gharian (1933) and Zliten (1935). Here the disease had probably been brought in from Tunisia as the sanctuary of Sidi Abdulsalam presented a staging-point for those pilgrims who travelled to Mecca on foot (Muccio). Years free from epidemic outbreaks tend to reduce gradually the resistance of the population.

In December, 1937, a few cases again occurred in Gharian (7) (Modica) which expanded during the ensuing months so that on average there were at first no more than ten cases a month in the Zuara-Nalut-Gharian-Zliten-Misurata area, with a maximum of 18 in May and a decline in summer. In the years 1938/39 the outbreak began to assume the dimensions of an epidemic and 188 cases were recorded (Map 14).

1939/40	4 cases	1944	91 cases
1941	116 cases	1945	52 cases
1942	650 cases	1946	95 cases
1943	558 cases = 1,200 cases among about 10,000 people	1952	29 cases

Again and again instances and small foci arose sporadically, apparently among the nomadic population especially as is suggested by the data for the years 1959/1960: (21 and 11 respectively in Tripolitania; 15 and 40 respectively in Cyrenaica). Mobile bathrooms with free supplies of soap and disinfectants travelled around during the autumn months and had the effect of further lowering the number of cases and also causing a decrease of the disease in the Fezzan in 1961/63.

4. Relapsing Fever

Another old epidemic disease of significance in Libya, *relapsing fever,* continues to be significant today. There are two typical manners of transmission: first, by lice which is known as the European type and secondly, by certain kinds of ticks and known as the African type. The pathogenic agent of different species are secreted with the excrement of lice, and occur in their salivary glands as well. In the case of ticks, transmission takes place through the sting or by means of the coxal secretion. By scratching the secretion is rubbed into superficial skin injuries. The ticks which transmit relapsing fever belong to the family Argasidae, which in contrast to the other great tick family of the Ixodidae, lives like bugs — (when seen from dorsal their head is not to be seen) — and hide in cracks in wood or loam walls, only leaving their retreats in order to suck blood. They also live in the holes of mice, rats and other small mammals. The following carriers of the disease have been established:

Argas persicus in Benghazi, Kufra, Marada, Tobruk and Tokra.

Ornithodorus savignyi in Augila, Kufra, Jalo, Jahgbub and Marada.

Ornithodorus franchini (of the lahorensia group) in Bardia, Kufra, Marsa Luch, Ghadames, Tgutta, Edri and Brak.

Ornithodorus moubata in Cyrenaica and Tripolitania.

Borrelia centralafricana are transmitted by Ornithodorus savignyi and the Borrelia Spirochaeta duttoni (which is distinguished by its size) by O. moubata (O. megnini is of no importance).

In 1911/12 a small epidemic of relapsing fever was recorded in Tripoli by the Italians; in 1913 there were 25 cases of Italian soldiers succumbing to it. A few further cases occurred in Cyrenaica (Map 14).

The following number of cases occurred in the foregoing years:

1915 in Barce (Merj) and vicinity	48 cases
1925/26 in Porto Bardia and Jaghbub	84 cases
1927 in Barce	a few cases
1929 in Gerdes Gerari	22 cases

From 1923 to 1927, there were some sporadic cases at several other places.

There were generally some cases of soldiers who got infected during military exercises without contact with lice. In 1929 were 18 Eritraean troops among them. During the last war most cases among British or Australian troops occurred in Tobruk with some in Benghazi; those affected had not left the town during the incubation period of seven days or had only stayed there for a few days.

The indigenous people only experience a mild form of the disease; it remains almost unnoticed or is mistaken for another infectious disease. Relapsing fever and typhus exanthematicus (typhus) are said to occur simultaneously (mixed infection), i.e. one changes and becomes latent when the other one occurs (Medulla, 1933).

This epidemic disease recurs seasonally, chiefly during the months of May to December, with maxima in August and December. Transmission of Borrelia by body lice takes place practically all the year round; by ticks it occurs from April to December with a maximum in May and June.

On the entire plateau of Cyrenaica (Jebel Akhdar) as far as Benghazi, spreading further to the Sirte and to Jaghbub and Bardia in the east, there are foci of relapsing fever caused by ticks which suck infected blood not only from humans but also from domestic animals, rats and mice. Nomads carry the disease around and caravans transport ticks along their trade routes amongst the boxes and bales. One of the larger outbreaks of the disease in Libya occurred in the Fezzan in 1942—44.

In April, 1942, groups of Meghara nomads between the Jebel es Sauda and the Fezzan who move to pastures in the Wadi es Shati in the Fezzan in summer, fell ill. They stay overnight in the caves of the Shati where they are bitten by O. franchini which remain in them. In May, the epidemic began at Sebha and Ubari, later in Murzuq and was finally carried to Dersh-Gadames and Sinauen, where it reached its peak in August, 1943. It moved along the trade routes to Tunisia and to the coast and on again to Algeria (Tuggurt). In Gorda (an oasis near Sebha where the caravans rested) in the Fezzan, 224 people of a total of 750 inhabitants were found to be infected in the summer of 1944. In the Fezzan the death-rate was 8—10% of all cases. About half the population of the Fezzan are said to have been infected by the disease in 1942—44. Again in 1947 there were some 100 cases. In the oases of the Fezzan, numerous ticks can be noticed on the palm-bushes. At noon I often rested in the shade of the palm-trees. After a few minutes numerous ticks were already on the move towards us. In the course of my journeys I have been bitten twice or thrice at most, not much more than the indigenous guides. Ticks seem to prefer camels which were plagued by a few blood-sucking animals after every halt.

It is, however, likely that are still groups of nomads in the mountains of Cyrenaica periodically suffering from small epidemic outbreaks. In Tripoli as well, there are probably still small foci because of the immigrants from the oases of the Fezzan who stay in the shanties on the outskirts of the city. In 1954 about 15 cases were still being treated there.

5. Cholera

It is scarcely possible to establish how often and when *cholera* occurred in Libya. There are said to have been some cases in the old part of the city of Tripoli and in some tents on the outskirts in 1876, but the epidemic outbreak did not spread. Tripoli appears to have been spared the last great cholera pandemic in 1892. Only in 1910 did it occur as an epidemic in Tripoli and its vicinity and this caused 308 people to fall ill and 200 to die within three months. In 1911, 1,048 cases of cholera with 332 deaths were recorded. Since then the disease has died out in Libya, especially as hygiene conditions were fundamentally improved by the Italians. In the interior, especially in the Fezzan, the cholera vibrio encounters unfavourable conditions. It can hardly survive in these areas because of the increased aridity.

II. Endemically Occurring Infectious Diseases

a) Infectious Diseases Transmitted by Insects

1. Malaria

Malaria occurs everywhere in Libya and until the eradication programme of the W.H.O. was inaugurated in 1959, never showed too great a number of cases nor hit the native population very hard. In the 17th century it has been estimated that 9.5 per 1,000 inhabitants, i.e. about 6,000 to 6,500 people, were infected. According to the W.H.O. calculations, only 0.019% of the national area was infected in 1958 and only 2.58% of the total population was thought to be threatened by the disease. If one third of those at risk was actually infected, it would, if related to the population of the 17th century, correspond to the rate of infection of that time. Apparently no essential shift in the relation of infected to non-infected people has taken place. The description is based on the infection records from the 'twenties onwards.

Malaria plasmodia are transmitted by mosquitoes belonging to the genus Anopheles. The parasites firstly develop sexually while guests in the mosquito and secondly asexually in the blood of man following a sting by some infected mosquito. During the latter stage the gametes come into existence, the absorbing of which when stinging a sick person infect the mosquito once more. Only female mosquitoes suck blood. Three sorts of plasmodia are distinguished, which as parasites transmit malaria quartana (Plasmodium malariae), malaria tertiana (Pl. vivax) and malaria tropica (Pl. falciparum). The last of these does not occur in Libya.

Following the actions by the Italians and WHO against malaria scarcely any fresh infections of malaria occur nowadays in *Tripolitania.* Even before 1935, the situation was different (see Map 15). There were several areas with particularly favourable conditions for the development of the Anopheles, in the vicinity of which numerous people lived. Two malaria foci were known in the environs of Tripoli which were cleared up soon after the occupation by the Italians. Ain Zara in the south in front of the town was an area with swamps between the dunes which were fed by groundwater and at times of high water in autumn and winter by the Wadi Megenin as well. Here the caravan routes from the south and the Fezzan terminated and here the caravans assembled for their return journey. Here, too, the malaria-infected people could always be found. Hardly any area could have been more favourable for the spreading of a disease. Nowadays the improved area is hardly touched upon by traffic; the caravan trade has ceased. The attempt to elimate the focus near Tadjura in the east of the densely settled Tripoli oasis was equally successful. The mosquitoes were annihilated or greatly reduced by the drying-out of the swamps there and the drainage of water and the population was treated with appropriate medicaments.

West of Tripoli further small malaria foci (Ciottola) had formed in the oases along the coast. Anopheles multicolor and superpictus, too, lived in the agriculturally-used irrigation areas. In El Maia, Tuebia Zanzur, Mohammara (Hashan), Zawia, Sabrata, Agelat, and Alalga infections kept recurring, attaining some 100 cases in certain years. Conditions were similar east of the Tripoli oasis at the mouth of the Wadi Targut (A. turkhudi), in the Wadi Maid (near Gasr Garabulli), Fonduk Nagazza, Wadi Ramla, Wadi Homs and Wadi Caam. In addition to the species of mosquitoes mentioned above, the Anopheles maculipennis as well as the Anopheles algeriensis and A. constanti were recorded near Tadjura and Homs in 1943.

According to Ragazzi, in 1933, about one third of the population of Tauorga and its environs were infected. Tauorga presents a third focus of the disease thanks to its large swampy sebkha, although its climate is said not to be especially favourable to the development of the Anopheles as it is at times too cold and at

times again too hot and dry. Of 500 mosquitoes examined 12 per cent. were found to be Anopheles mauritianus apart from A. maculipennis; as for plasmodia, only Pl. falciparum were found, probably imported.

For about six months of the year the oasis is inhabited only by some 1,000 people, the remaining ones staying only for the time of the date harvest. The large NaCl (3.42%) content in the soil does not permit the cultivation of any other plant but the date-palm tree. Houses are constructed of palm logs, mud, and hardly of stone. They are oblong, lacking windows, fitted with no more than one door — thus providing a good retreat for the mosquitoes. The small settlements are situated on little islands amidst the swamps; small channels have been built for the irrigation of the palm-trees, the stagnant water of which provides a fine breeding place for the mosquito larvae.

Ninety per cent. of the population of Tauorga are Negroes whereas Tripolitania has only twenty per cent. Negroes. Earlier the entire district showed a high rate of malaria infections (MODICA and others, 1960). In Tauorga 11 per cent. of the Negroes and in Tripolitania only 4.2 to 4.5 per cent. of the Negroes suffered from the disease. Here the number of malaria cases was three times that of the remainder of the country. Malaria has receded, but sickle cell anaemia has taken its place; it showed the following modifications between 1957 and 1960:

	Tripolitania 1957		*1960*		*Tauorga 1960*	
		HbS		HbS		HbS
Arabs	483 (80.5%)	0	1,232 (80%)	0	18 (7%)	0
Negroes	117 (19.5%)	5 (4.2%)	308 (20%)	14 (4.5%)	242 (93%)	27 (11.1%)
Total	600	5 (0.8%)	1,540	14 (0.9%)	260	27 (10.4%)

All carriers of sickle cell haemoglobin are Negroes. In Tauorga 11.2 per cent. of them suffer from sickle cells, whereas only 4.5 per cent. were recorded in the remainder of Tripolitania. Either a new endemic malaria focus is being formed here or a competition between two factors has sprung up, i.e. sickle cells take the place of malaria plasmodia (MODICA). Further research into the appearance of sickle cells planned in areas of racial composition similar to that of Tauorga, which used to be foci of malaria.

Away from the coast in the south of the Jefara, small malaria foci have come into existence along the spring-line which formed in part of the Tripolitanian Jebel scarp. Water emerging from the talus foot created swamps in the small oases of the wadis; the water channels became choked with weeds. Especially severely attacked were Tigi and Giosh where Anopheles multicolor and A. sergenti lived. The spring-line extends eastwards beyond Shekshuk to Bu Gheilan.

Cyrenaica is now more or less free of malaria. At the mouths of wadis, however, where water is dammed up behind a bank of sand or gravel, as for example at the mouth of the Wadi Latrun, Anopheles multicolor, A. turkhudi, and A. martari larvae were found. Thus almost every year (1964) some cases of fresh malaria from the Kersa, Latrun and Ras Hilal settlements in the area between Derna and the Ras Hilal are admitted to Derna Hospital (Klug). In 1956, 150 new cases were still being reported. The conditions around this focus does not seem to have been fully improved yet. Swamps and lagoons around the city of Benghazi, too, were previously malaria foci. They were cleared by the Italians. In the Marada Oasis about 20—30 infections were reported during September—October, 1956. Apart from this the south-eastern desert area seems to be free from the disease (Map 15).

In the *Fezzan* malaria was most widely spread. A. benign malaria tertiana with Plasmodium vivax seems to be predominant. The Anopheles which transmit malaria occur very frequently in the Wadi es Shati, the Wadi Adjal, in the Hofra and in the Wadi Hekma. According to ZAVATARI the Anopheles multicolor is supposed to be the most important of the mosquitoes. It can be found in almost every oasis of the Fezzan since it is capable of developing in even very salty water. As further species of Anopheles he cites A. sergenti and A. superpictus to which VERMEIL has added A. broussesi from el Barkat (Ghat territory) and the A. hispaniola (Brighanti). It is doubtful whether these are joined by A. gambiae at Ubari and Edri (Lodato). Other species of mosquitoes are Aedes mariae, Culex pipiens and C. fatigans, all of which breed in derelict wells. Nests of culicide larvae were found by VERMEIL especially at Ghat, Gatrun and in the Hofra es Shergia.

In almost all oases LODATO (1933) noticed the small number of women affected by malaria (7—9 per cent.) in contrast to the high percentage (96 per cent.) of infants who are stark naked by day and night during spring and summer, of boys (70 per cent.) wearing thin, white shirts and of adult males (40—50 per cent.), in spite of the long linen underpants, shirts almost down to the feet and often even a barrakan which is wrapped around them when they are asleep. So women are least affected although they do the hardest work and are often wearing nothing but a single, thin, blue linen shirt together with a black cloth. LODATO noticed that women use a strongly-smelling oily mixture composed of 11 different ingredients; they are completely impregnated by this up to their hair and even their ornaments as well. The characteristic aromatic smell of the Fezzan women is perceptible up to distance of five metres and more in the open air; one drop of the oil rubbed into the palm may still be felt after three days in spite of washing the spot. The mosquitoes apparently dislike the smell and prefer the skin of children and men who use a rose perfume. Infected women, mostly belonging to the poorest class, do not use this oil.

With the exception of the Hofra es Shergia (east), the southern Wadi Hekma and the Buanis (Sebha Oasis), all oases of the Fezzan were infected with malaria before the war. Murzuq, the old capital of the Fezzan, in the Hofra el Garbia suffered badly; caravans coming from the south, which supplied its market, used to rest in front of its well for several days. NACHTIGAL in his accounts of his travels, recalled that already at that time, Arabs and Berbers were on occasion not allowed into the town because of the fever. In the autumn and winter of 1869/70 he himself suffered from weekly attacks of

the fever. Brackish groundwater pools at the town walls and swamps in front of the old fort in the town were breeding places for the mosquitoes. The swamps were drained by the Italians while some of the pools in front of the walls are still there (1962). Gambusia helbrocki were then successfully put out there for the purpose of exterminating larvae (ZAVATARI). Nevertheless, malaria was the main reason for the removal of the capital of the Fezzan from there to Sebha which is a much healthier place.

Not only in Murzuq but also in the remaining oases, the Italians made an attempt to control the disease. The population was treated with quinine. At Edri and at Ubari they succeeded in ridding themselves of the mosquitoes by improving the sanitary conditions. They did not achieve their aim in Brak and its vicinity (Wadi es Shati), which are rich in water. The areas mentioned above appear to have been hardly or only slightly infected. Most of the oases in the wider environs of the Fezzan were free from malaria: the remote, little-frequented Fogha, the oases of Ghat, Wau el Kebir which was used as a place of exile and Wau en Namus, the lonely mosquito oasis with its lakes and plants. The Kufra oasis, too, seems to be free from malaria. Within two years RICCI (1934) treated only 28 cases at El Jof and vicinity, all of which had picked up their infections in Egypt or in the Sudan. Although mosquitoes occur (JANY), no Anopheles were found in Tazerbo for instance, and probably there were also none in the remaining oases. With the exception of Marada the oases between the 28th and 30th parallels of latitudes are free from malaria, partly because of little and brackish water (Jalo), partly, it would appear, because of their remote position (Ghadames for example). Hun, the seat of the military command of the southern territories appears to have been free from the disease.

Soon after the occupation of the country, Italian biologists and physicians had systematically examined the occurrence of malaria and mosquitoes, especially of those species of Anopheles which transmit this epidemic disease, and had started to fight it by improving the sanitary conditions and by treating the population. This work was interrupted by the war 1939—43, and much that had been gained was undone.

After that the occupation powers, especially the Army Health Service, resumed activities in the areas infected by malaria. The first to be tackled was the Tauorga malaria focus. Between 1954—57, spraying took place in the town and its vicinity and the population was treated so that no new infections were reported to the dispensary after 1957. In the Fezzan, treatment was restricted to the taking of quinine (until 1952); then, in 1959, the eradication programme of the W.H.O. was started, taking over all further tasks after selecting the main infected areas (preparatory phase). There were two groups of oases south-west of Tripoli, the centre on the coast west of Derna and most of the oases of the Fezzan (attack phase). Larvae and mosquitoes inside and outside the homes were fought with D.D.T. and oil and by spraying the surface of waters, breeding places were cleaned and drained, people infected with malaria parasites were treated (1959—61). From 1962, remnant foci were still being rooted out, people supervised by means of blood tests and wherever necessary, a radical drug treatment was carried out (consolidation phase). Every two months the villages are visited. Malaria check-points were established at the borders of the country. The consolidation phase is to finish by the end of 1966; then the maintenance phase with supervision by the public health service will commence.

The W.H.O. programme aims at the improvement of sanitary conditions in Libya and at the complete eradication of malaria. How far it has succeeded will be shown by the statistics of disease in future years. Owing to a relatively sparse population, few larger settlements, the dot-like distribution of the population of the oases and the short flying distances of the mosquitoes averaging 1.5 to at most 5 km., the spread of infected Anopheles is small. There is, however, the possibility of spreading by car or aircraft, the possibility of infected persons moving through shanty towns on the outskirts of towns to the towns proper and the creation of new foci as people such as these as well as the mosquitoes move to the oil-port under construction and settle in agricultural areas which are being opened up.

2. Leishmaniasis

People in Libya are known to be suffering from *cutaneous leishmaniasis* (Leishmania tropica) which causes spots and pimples which become ulcers (oriental boil, Aleppo boil) and from visceral leishmaniasis (L. donovani, Kala Azar). Dogs, jackals, hyenas and rodents are supposed to act as hosts to Leishmaniasis. In the year 1925/26, the Italians examined 117 dogs in Tripolitania and found two sick ones; from 638 animals examined in the Cyrenaica, 7 from Merj were found to be sick, 76 from Tolmeta and 555 from Benghazi has one sick one each among them. The protozoa are transmitted to man by sand-flies (phlebotomes) occurring in several places in Cyrenaica and Tripolitania.

Of the phlebotomes, P. sergenti and P. papatasii are recorded in Libya for the leishmania tropica and in addition types of the P. major and P. perniciosus for the visceral form (L. donovani) (of the P. major group, P. minutus was found in the Benghazi zone and P. langeroni in Cyrenaica).

The cutaneous form appears mainly towards the end of summer during the main flying time of the phlebotomes and is predominantly a children's disease, a general disease affecting children from the first to the fifth year of life. Kala Azar generally presents itself as a splenomegaly with chronic fever. But liver, bone marrow, glands and muscles are also penetrated by the parasites. Adults are not spared by the disease but it makes itself felt in a less severe manner.

In the literature only isolated cases of leishmaniasis are mentioned. In 1910 the Turks treated a case of *Kala Azar* in Tripoli. After the Italian occupation twelve cases were reported from the area around Homs and between 1912—23 some 30 cases occurred in Tripoli (FRANCHINI). MEDULLA mentions three cases in 1929, the bacteriological laboratory in Tripoli five positive cases in the period from 1939 to 1952. At Barce in Cyrenaica a child aged four fell ill (spleen puncture positive), while two cases remained suspected; then there was a child in Tolmeta, whose parents lived in Barce, six people in the Gubba encampment and a 20-month old child together with its 40 years old father. The Table XIV for the years 1959/63 shows two cases in the Fezzan and six in Tri-

politania. There are altogether only few cases mentioned. There are certainly many more, especially among the nomads whose children are in continuous contact with dogs, but they have not become known or been diagnosed as suffering from a disease of similar symptons.

3. Dengue

Dengue takes a mild course and as it is accompanied by headaches, pains in the joints and muscles and cutaneous eruption (rash), it is similar to measles, scarlet fever and urticaria. The virus is transmitted by the Aedes aegypti mosquito. Epidemics of dengue in Cyrenaica in 1859 and 1879 have already been described by the Turkish physician PASQUA (MEDULLA). In 1913/14, sporadic cases occurred in Tobruk, in 1914 at Apollonia and in 1928 there was a more severe epidemic in Benghazi and at South-Benghazino at the same time as a large epidemic swept through Greece, in the course of which 80 per cent. of the population of Athens fell sick. Since 1928, almost every year brought a number of cases in Benghazi during the months of September/October. In 1930 it developed into a small epidemic again, originating from the Mohammedan quarter of Benghazi. Since then every now and then a largish number of people become affected. The statistics for 1963, however, only show four cases in Cyrenaica and 16 in the Fezzan in 1961.

4. Pappataci Fever (Sandfly Fever)

The symptoms of the *pappataci fever* are very similar to those of dengue with the result that both diseases may easily be mistaken for one another. The virus is transmitted by a midge of the same kind (Phlebotomus papatasii), in which the exogenous development of the virus takes a course similar to that of the malaria plasmodia in Anopheles. Breeding places of the mosquitoes are in channels, pits and damp cellars. Statistics of infectious diseases do not mention pappataci fever as it seldom seems to occur as an epidemic although it is known throughout the entire Mediterranean area.

b) Infectious Diseases Transmitted by Water and Foodstuffs

1. Amoebiasis (Amoebic Dysentery)

Amoebiasis is a disease of warm climates. Entamoeba histolytica lives as a parasite in the large intestine of humans without at first causing any damage (minuta form); only when the way to the mucous membranes of the intestines is opened to it does it start to become a pathogen (tissue form). This happens chiefly through bacterial infection which causes ulcers so that bacterial dysentery and amoebiasis are often found converting into an association.

Transmission of the amoeba cysts takes place as a result of contamination of soil, living quarters and water. Flies, rats and mice are engaged in spreading it. Transmission from one human to another is also possible. During the last war up to 26 per cent. of all German soldiers in Libya were carriers of cysts. Additionally many suffered from amoebic and bacterial dysentery. After the return to Germany the amoebiasis was shaken off. In Tobruk, 30 per cent. of the population was found to have protozoan cysts in their intestines, i.e. Entamoeba histolytica and Lamblia intestinalis, a flagellate, the cysts of which occur frequently in the intestines, particularly those of children, but are pathogenic only in the case of massive infection (Giardiasis).

In 1935/36, 15 per cent. of the patients in the Tripoli hospital suffered from amoebiasis (TRIPODI) while 20—25 per cent. of the population at Tarhuna, indigenous and Europeans alike, were infected. The disease is often followed by liver abcesses and by the accumulation of amoeba in the lungs and, more rarely, in the brain.

In 1939 the bacteriological laboratory in Tripoli established 229 cases of amoebiasis (from all over Tripolitania probably), the figure decreasing to 29 cases only in 1952 and increasing again thereafter. There were isolated cases of amoebiasis at Tauorga in 1933 (RAGAZZI), one case at Zliten, three (TRIPODI) from Tripolitania in 1948. ANGRISANI found 3 per cent. of all patients in the eastern districts of Tripolitania in 1949/50 to be amoebiasis.

The disease occurred frequently but in a mild form in *Cyrenaica* over recent years (KLUG). According to publications in medical journals, isolated cases keep occurring, at times increasing in numbers and possibly leading to serious epidemics as was the case in Derna in 1912/13 (TESTI).

In the *Fezzan* (ZAVATARI), as in Kufra (RICCI), amoebiasis is said to occur only as an importation. This is, however, contradicted by the statistical figures of the years 1959/63 which suggest that there are numerous carriers of cysts. As for the whole of Libya, 20—30 per cent. of the population are supposed to be carriers of amoebae. SCADUTO puts the number in Tripolitania at 8—10 per cent. (and 3 per cent. Entamoeba coli), NASTASI at 14.85 per cent.

2. Bacterial Dysentery

Only a few positive cases of *bacterial dysentery* (especially of the Shiga-Kruse type) were established in the bacteriological laboratory (1939—52 but see also table covering the years 1959/63).

3. Typhoid Fever

Typhoid fever is a bacterial fever, located mainly in the intestines, from which a general sepsis develops. Infection occurs as a result of primitive way of life with bad sewage conditions which caused pollution of the soil, men's hands, of foodstuffs and drinking water. The germs are taken in by people. Man is the only being which harbours the bacteria of this salmonella type. Children are often only slightly affected. After the person concerned has regained his health, germs are still excreted for a time in urine and faeces (permanent carrier), but healthy people as so-called carriers can also pass on the germs. The spreading of endemic typhoid centres may occur within human settlements (village or town) especially during the warm months of summer and autumn.

Typhoid fever is endemic in Libya. There are several descriptions of cases of typhoid fever, even of typhoid in connection with paratyphoid fever C in the eastern districts of Tripolitania in the years 1949/50 (1½ per cent. of all cases according to ANGRISANI) and three cases from Beida in Cyrenaica. Typhoid fever is generally regarded as being rare in Libya but the bacteriological

laboratory in Tripoli carried out some 1,000 tests with positive results in the period 1939—52, and statistics for the period 1959—63 also show a few hundred cases each year.

4. Paratyphoid Fever and other Salmonelloses

The agents of *paratyphoid fever C* are two kinds of the salmonella group, usually found with animals and acting as toxins on meats and foodstuffs. With humans, especially with children, they cause unspecified bacterial enteric fevers. CAMPOLILLO mentions 15 infected soldiers from Homs who suffered from enteritis together with infestation with worms (1938). In the period from January to June, 1953, ANGRISANI recorded 252 cases at Tadjura, 190 at Miari south of Tripoli and 64 at Beni Ulid. Few cases are reported for the years 1959—63, so that it can be assumed that in this case, too, there are only occasional epidemics.

c) Infectious Diseases Transmitted by Contact

1. Tuberculosis

Tuberculosis appears to have already existed for a long time in the coastal districts of Tripolitania particularly. In certain years, as for instance in 1887, it occurred in large numbers, wiping out the slaves especially as they were poorly accommodated and mostly frequently suffering from malnutrition. In 1912, the Italians reported the existence of 88 T. B. patients at la Hara, the old densely settled Hebrew part of the city of Tripoli, as well as some cases at Gharian and Tarhuna. After the end of the colonial wars in the 'twenties they therefore set up the first centres in Tripolitania in order to fight tuberculosis in Tripoli, Zawia, Tarhuna and Homs. Towards the interior they made do with a few extensions as the numbers of infections appeared to decrease greatly towards this part. In 1937, the Italian government sent a health commission to the Fezzan which examined 8,917 persons at 72 different places. They did not note more than two cases of open tuberculosis and a few cases with fibrotic forms. The outcome in Kufra and Tibesti in 1931 had been similar so that there were indications that tuberculosis is rare in desert areas. The inhabitants of oases live in small villages, the families apart from one another, albeit in small dwellings and huts. Moreover, the isolated family groups are in the open air a lot so that they seem to be protected against mass infections.

Due to the last war many institutions which the Italians had set up in order to fight tuberculosis were dissolved or closed down as in the case of the Sanatorium Generale Caneva (1941) which had only been founded as recently as 1938. Many natives had fled, chiefly to Tunisia, but returned after the war. Uprooted nomads and emigrants from the Fezzan moved to the coast, especially to Tripoli and a few other towns (Benghazi and others) where they were forced to live close together in shanty towns on the outskirts of the town without any sanitary installations. There was little food, deficient in vitamins and protein, and, according to FAO comprising less than 2,000—2,300 calories a day.

Table IV. *Tuberculosis in Libya*

a) *Fezzans* in the Government Clinic in Tripoli 1950—55 (CL. LOLLINI)

Non-infectious	Infectious form unilateral	multilateral	Mortality	Onset of illness in: Tripoli	Fezzan
20%	20%	20%	40%	73%	27%

b) *City of Tripoli:*

Open form of tuberculosis		Positive diagnosis of tuberculosis		
1939—44	79%	1939—1946	Europeans 514=21.47%	Arabs 714=37.61%
1945—49	85%	1947—1950	Europeans 445=22%	Arabs 2,016=34.63%
1950—54	74%			

c) *City of Tripoli:*

Tuberculosis mortality per thousand inhabitants:

1916	Arabs 5.16	
1917	Arabs 9.13	
1939	Arabs 1.43	
1945	Arabs 0.39	Europeans 0.63
1950	Arabs 0.67	Europeans 0.39
1954	Arabs 0.33	Europeans 0.12

d) *Number of deaths in Tripolitania and the Fezzan* (excluding the City of Tripoli) Fezzan:

1940: 41	—
1945: 27	—
1950: 56	4
1954: 69	4

Thus after the war throughout Libya and especially, however, in Tripolitania, tuberculosis increased greatly. The disease spread in areas where it had been previously almost unknown. The same fact was observed in the Fezzan. Here tuberculosis quickly developed in an alarming manner. Especially easily affected were those Fezzans and even Arabs of Tripolitania who moved to Tripoli or to the coast. Their physical resistance against the

disease was low as they were not immune to the same degree as the local people and members of the older civilized nations they encountered there. They developed an active form of tuberculosis, which took a rapid, severe course, soon terminating in death.

In 1953, UNICEF conducted a vaccination campaign throughout Libya. BCG was used for the vaccinations (vaccination after D. NICOLAIDES). The WHO hoped to achieve sufficient immunity of the non-infected section of the population by increasing their specific resistance. The active form of tuberculosis was then followed by the chronic one, the problem of which is beginning to be experienced by the Fezzan (CL. LOLLINI). The number of deaths decreased and that of sicknesses increased. The index of tuberculosis remained high in Tripolitania as well and even higher for men than for women. Whereas cases could previously be discharged speedily, fluctuating numbers of new patients have to be treated now and chronic cases have to be tended (tuberculosis of the lungs, abdomen, bones and glands) and supervised after recovery. Thus tuberculosis becomes more akin to that of the European type and becomes milder and chronic.

Large-scale tuberculin tests were out amongst the Arabs and particularly among infants and schoolchildren. The positive results coincided with the average density of cases in a given area. Percentages were very high among 15—18 year old schoolboys in Tripoli and its vicinity (CL. LOLLINI, 1960).

Tripoli and environs	79—81%
In the Tripolitanian Jebel	25%
In the Fezzan	19—47%

About 1,000 new cases of pulmonary tuberculosis and about 100 cases of other kinds of tuberculosis infection are said to occur each year. Attempts are being made to combat the disease by the establishment of new wards in hospitals, new out-patient wards and policlinics, by the isolation of infected persons and by vaccinations, by radioscopes and sputum tests of the population (5 per cent. were proved to be infected). As a prophylaxis persons at risk are provided with foodstuffs and additional clothing, primary schools distribute bread, soup and milk and efforts are made to teach the women hygiene. Nowadays infected Arabs live in hospitals (sanatories) for long periods and attend policlinics regularly after their discharge. Whereas in former times restoration to health was the exception rather than the rule among Arabs, there are surprising numbers of them now as a result of antibiotic and chemotherapeutic remedies. According to the national anti-tuberculosis service, about 6,000 cases are treated annually in Tripoli. In Benghazi the anti-tuberculosis service has been operating since 1963.

2. Trachoma

Trachoma is not related to the seasons; it is an endemic, infectious, follicular conjunctivitis of a chronic nature and is marked by the occurrence of numerous swollen follicles (Trachoma particles) leading to the destruction of the glandulous organs of the conjunctiva and to the formation of corneal ulcers. The combination of bacterial inflammation (irritation) (especially Gonococcae) and trachoma is most dangerous.

The *Fezzan* is the area most affected by trachoma: the morbidity is estimated to be more than 60 per cent. of all people infected by it. Negroes are less prone to infection. Between the north and the Fezzan there is, however, an area of nomadic tribes and these people are much less affected than sedentary people living under otherwise similar conditions. The more civilized coastal area used to be less affected but has shown a great increase in recent times due to migrations from the southern areas to the coast. Thus in the 'fifties, 30 per cent. of the population in the coastal areas near Zliten and only 7 per cent. on the Jebel, were said to be suffering from trachoma or its aftermath (ANGRISANI, 1952). In the shanty towns on the outskirts of Tripoli, the number of cases is said to have risen to 70 per cent. of all inhabitants. In 1931, MEDULLA reported trachoma infections between mother and child as reaching 90 per cent. Active treatment and the instruction of the inhabitants are said to have brought about a decrease to 5—10 per cent. (KLUG).

In 1937, CASETI, the ophthalmologist who examined 8,917 persons in the Fezzan, reported on the high number of infections in the southern oasis districts. Of the 8,917 persons examined, 5,161 suffered from eye disease, 4,128 of which were of a trachomatous sort. A complete list of all diseases has been compiled, the most important of which are given below:

Acute trachoma	2,091	Conjunctivitis catharalis	374
Trachoma and Conjunctivitis	1,011	Conjunctivitis angolare	62
Trachomatous scarification	1,026	Conjunctivitis gonococc.	6
		Pterygium	411
		Total blindness	58

In the *Kufra oasis* as well, eye disease was widespread.

The great incidence of trachoma cases among the population soon forced the Italians to take suitable action. BALBO, the Governor, founded the Centro di Studi di profilassi per il trachoma in connection with the Red Cross in 1938, and this is now continued as the Epidemiology Centre for Trachoma which maintains two mobile eye clinics. The population receives instruction chiefly at the mother and child health centres but also at school. Teachers supervise their pupils and treat them with aureomycin ointment and sulphonamide tablets. Schoolchildren are systematically examined. These measures have resulted in an improvement in the situation, although the disease is still widespread as is proved by the 4,126 cases recorded in Tripolitania in 1963 (see Table XIV). The flies which contribute to the spreading of the disease are being actively combated.

3. Other Eye Diseases

Eye diseases occupy the first place in Libya. As a result of protein-deficiency and vitamin-deficiency, children are particularly liable to *conjunctivitis* in association with bacterial infection, transmitted by dirt, dust and flies from mothers and elder children to the babies. Large numbers of children, who are in any case weakened, die from eye disease. In hot desert areas the bacterial eye infections are most widely spread and are subject to seasonal fluctuations there. In Libya for instance, autumn conjunctivitis occurs at the time of the date harvest (flies) and often leads to rupture of the cornea and to a prolapse of the iris within a few days (vitamin-A-deficiency).

4. Leprosy

Leprosy, endemic in the African Mediterranean area, sporadically occurs in Libya as well. This disease associated with low standard of hygiene is produced by bacteria which children are most likely to attract. It is difficult to ascertain how many sick people there are in fact in Libya as only a fraction of all people affected are registered and new cases are being added constantly. In the year 1937, the Italians ordered the isolation of infected people by law; they were gathered in the colonial hospital in Tripoli. According to NASTASI there were then 15 patients (12 men and 3 women). From 1923 to 1953, a total of 190 lepers (175 Libyans, 6 Italians, 8 Jews and 1 Erythrean) were recorded according to ZACCARIA; today there are 100 patients in the government hospital. Centres of infection are supposed to occur near Misda, in Zliten and Misurata. During recent years patients from Cyrenaica have also come to Tripoli. Here the WHO recorded 25 new cases (= 0.07 per cent. of the population) during the years 1947—49. In the dermatological ward of the government hospital in Benghazi, 0.3 per cent. of all treated patients suffered from leprosy in 1960, 0.28 per cent. in 1962 and 0.12 per cent. in 1963 (DOGLIOTTI).

5. Venereal Diseases

Gonorrhoea, which was not even frequent among British and German troops during the last war, occurs relatively seldom nowadays and mostly still as Blennorrhoea among very young children (see trachoma).

More frequent, however, is *syphilis,* especially in its secondary and tertiary form in the case of the Arabs. It is followed by venereal infections of the skin, mucosa, bones and the heart and frequently by cirrhosis of the liver and by nerve diseases (FELICE). RICCI reports some cases from Kufra where I saw one case myself; at Derna Dr. KLUG treated three or four cases. Syphilis is said to have receded considerably in Libya in the years following the war. DOGLIOTTI reported 8.8 per cent. of the patients in his ward of the Benghazi Hospital as being treated for syphilis in 1960, 7.7 per cent. in 1961, 7.0 per cent. in 1962 and only 5.8 per cent. in 1963.

6. Yaws

Framboesia tropica (yaws) — called *Pian* in Libya — occurs in isolated cases amongst Negroes (KLUG). It is contagious and produces raspberry-like papules on the skin. RAGAZZI maintains that there are some endemic centres of yaws in Tripolitania, especially as the nomad population lives in great isolation. In 1962, one case was reported in Tripolitania.

III. Other Infectious Diseases

1. Infectious Diseases of Childhood

As everywhere, young Libyans are liable to infectious childhood diseases. Diphtheria is said to be rare and to strike European immigrants chiefly; there is a marked distribution of poliomyelitis; chicken-pox, parotitis, measles and whooping cough occur frequently, both the latter often being severe in nature. They often create a disposition towards tuberculosis. All children seem to be affected by worms (especially ascarids and pinworms) at times and nearly all by Schistosoma haematobium in the Fezzan, without, however, suffering strong haemorrhage.

Every year there are isolated cases of *diphtheria.* In the period from 1945 to 1951, there were on average only four cases for every 100,000 inhabitants in Libya, rather more in Tripolitania and rather less in Cyrenaica. ANGRISANI (first half of the year 1953) mentions some cases from Tripolitania. In Sebha (Fezzan), too, diphtheria sometimes occurs as a childhood disease. Over the recent years KLUG did not remark any case in Cyrenaica, nor any of scarlet fever, which occurs only sporadically in Libya and mainly among Europeans.

Meningococcal meningitis, erysipelas (streptococcae) as well as *septicaemia* (staphylococcal sepsis) with abscesses, angina and osteomyelitis are rare among children and babies. *Diseases caused by pneumococci,* too, pneumococco-peritonitis as well putride bronchopulmonitis are found relatively rarely among small children and in fact only a single case of bronchitis with numerous spirochaetae in the sputum is mentioned from Tarhuna (MEDULLA). According to KLUG, *Angina Plaut-Vincent* does not occur in Cyrenaica and possibly not in the whole of Libya.

2. Virus Infections

Virus infections caused by transmission from one person to another, often with numerous cases are also reported from Libya (Table XIV covering the years 1959 to 1963).

Measles only occurs as epidemics proper in towns or in small outbreaks in the country, mainly in schools. From January to June, 1953, for example, ANGRISANI counted 225 cases at Jado, 188 at Nalut, 120 in Beni Ulid, 99 at Tarhuna, 64 in Tripoli and 66 at Sabratha, but less at other places in Tripolitania. Secondary diseases (encephalitis for example) are said to be relatively frequent, especially in the oases. At Jalo (Cyrenaica) about 100 people died after no measles had occurred before over a generation (KLUG).

German measles together with subsequent diseases are not over frequent, whereas *chicken pox* which mainly affects children, although of a mild sort, is highly infectious.

Whooping cough (pertussis) occurs frequently as well as with meningitis; in towns it is definitely of an endemic nature and at times very severe, as for example, in Benghazi (KLUG). BERTI reports on small epidemics from the Msellata (Tripolitania) which follow a graduated course.

Mumps (parotitis epidemica) often strikes adults who are then usually not spared the complications. For the period January-June, 1953, ANGRISANI records 271 cases from Tripoli, 127 from Zawia, 103 from Sabratha, 30 from Tadshura, 55 from Homs and 51 from Tarhuna.

As for other infections caused by viruses, *Herpes Zoster* is but rarely found, endemic *infectious hepatitis,* too, was only observed in isolated places, while *mononucleosis* chiefly affects the jugular lymphatic glands of very young children, albeit in a mild manner and relatively rarely.

Influenza followed by *polyarthritis rheumatica* is frequent in Libya. It occurs in winter and summer as a result of temperature fluctuations and relatively high humidity in the coastal zone (MEDULLA). The poor living

conditions of the population, relatively thin clothes even in winter as well as sleeping on the often cold and damp ground, all help to create the conditions for rheumatic fever. From January to June, 1953, ANGRISANI counted 48 cases at Bianchi, 14 at Zanzur, 12 at Gharian, 18 at Misda, 14 at Beni Ulid, 58 at Zliten and 78 at Tarhuna.

Poliomyelitis has always been endemic and frequent in Libya. The disease predominantly affects children, among whom the death-rate is high in any case. Severe cases of poliomyelitis together with encephalitis, paralysis of arms and legs, are rare; it may be assumed that there is a hidden immunity among the population. Together with the improvement in sanitary conditions, the relationship shifts from children to the infection of adults (KLUG, Cyrenaica) and together with this, upper muscles (respiratory and facial muscles) are affected more frequently.

Every year there are fresh cases of poliomyelitis and even small epidemics in places. For the period 1948—59, MILELLA cites 260 cases in Tripoli, 18 of which were Italians, 4 Jews and one Maltese, as well as 15 cases from the oases around Tripoli. During the first half of the year 1953, there were only five cases in Tripoli, one at Gharian, four at Homs (ANGRISANI). In 1956, 20 cases occurred in the Tripoli area and there was a small epidemic outbreak in Tripoli and its environs in 1963 and numbering 160 cases; this rose to 200 new cases in 1964. It is noteworthy that this could happen even though during the course of this epidemic in 1963 about 72,000 children under 15 years of age had been vaccinated in Tripoli. In the course of the last three years, six oases from Sebha (Fezzan) were treated in the government hospital in Tripoli (GIACOMETTI). With the aid of a mobile clinic (clinomobile), Dr. med. MEINCK carried out several hundred vaccinations in the Jebel during 1964. At Derna (Cyrenaica) there were no more cases after a vaccination campaign had been carried out, whereas previously two to three cases had come up for treatment each year.

3. Diseases Caused by Anaerobic Bacilli

The *bacillus phlegmonia emphysematosae,* which causes wound infection and is reproduced by spores, occurs only rarely.

Tetanus, which is caused by the metabolic products of the tetanus bacillus, is relatively frequent in new-born babies, due to the treatment of the navel cord with fine sand, in infants when wounds become infected and, as tetanus puerperalis in women during their confinement as well (KLUG, SELBY LOWNDES) (see Table VII).

Botulism, too, is found in Libya. The germ clostridium botulinum is a former of toxin on meat and foodstuffs as well as in preserves. It is countered by strict control of foodstuffs. In the intestines of man and beast the bacillus is a harmless parasite.

4. Fungus Diseases and Scabies

Fungus diseases — for instance like trichophytiasis — occur more often in Libya. Favus and microsporidiasis, which cause a form of alopecia, are even said to be very frequent (KLUG). According to KLUG (1964) scabies is rare in Cyrenaica, while ANGRISANI (1952) puts the number of cases at six per cent. of all patients at Gharian, Jefren and Jado.

IV. Helminthiasis

1. Bilharziasis

Bilharziasis as an endemic disease in Libya is chiefly spread in the Fezzan. In this latter endemic area the disease takes a relatively mild course, but in places up to 86 per cent. of the inhabitants are infected (Wadi es Shati). Children in particular produce urine which becomes bloody at the end of the miction but without, however, suffering from fever or any pain. This appears to be a matter of immunity, for immigrants from little infected or quite uninfected areas, especially from the coast, are both struck severely, although there were and probably still are foci of infection on the Libyan coast in Tripolitania as well as in Cyrenaica.

The schistosoms which cause the disease, Schistosoma haematobium and Schistosoma mansoni (the latter is said to occur in Libya only when it is imported from Egypt), are inhabitants of human bloodvessels; S. haematobium prefers the pelvic veins, the eggs penetrate the tissues which provide for these vessels and in shifting around they bring about inflammatory growths and processes which cause scars. S. mansoni lives in the liver and mesenteric veins. The ova are passed out together with urine and faeces respectively.

Only certain fresh-water snails can act as intermediate hosts. Having left them the cercariae, the larvae of S. haematobium and S. mansoni, penetrate the skin of bathing children or people wading in water as they cultivate their fields. The occurrence of snails conditions the number of infected cases.

In Libya Bulinus contortus is the predominant intermediate host. In addition other snails were found by the Italians, but their role as intermediate hosts has not been fully proved (see Appendix Table XII).

As has been proved in North Africa, the occurrence of snails depends on the chemical composition of the water. Bulinus contortus, for instance, can only live in water containing no more than 0.3 g. Cl/litre.

Italian as well as French scientists have investigated the occurrence of bilharziasis (urine tests for schistosome ova) and of their immediate hosts on several occasions. In the year 1925, DURAND established the existence of a focus of urinary bilharziasis and the occurrence of Bulinus contortus in Janet (85 km. south-west of Ghat). As far as the natives could remember, blood had appeared in their urine. On the strength of that, VERMEIL examined the Geltas on the slopes of the Tassili on the way to Ghat and was able to collect Bulinus contortus here easily as well as in the wells of the Ghat territory. Except for Ghat itself, the Italians had reported infection of the population everywhere here, amounting, for example, to 65.62 per cent. in el Barkat to 68.75 per cent. in Feuat, but had not found Bulinus contortus acting as intermediate host. VERMEIL assumes that they were therefore at a time when these molluscs were difficult to find (ZAVATTARI in the summer of 1931, GIORDANO in March, 1937, NASTASI in July, 1937). VERMEIL frequently found Bulinus contortus in many of the wells in the Ghat territory and especially near Feuat and el Barkat as far as Auenat (Sardeles); also Melania tuberculata at el Barkat and Limnaea laurenti and Planorbis pfeifferi and ehrenbergi near Ghat. In 1943, BOSCARDI found Bulinus (Physopsis) africanus here. The ovae of Schistosoma mansoni were found in infected people.

Bulinus and Biomphalaria are said not to occur together in the same water (cf. ANDERSON in Tunis). At the Abaric well near Ghat there are two waterholes only separated by a few metres, the one contains Bulinus and the other Planorbis. Here the viability of Bulinus is limited by salts in the water. In the vicinity of Ghat the dalu (well with a goatskin sack) is drawn by cattle. It is possible that there are also Schistosoma bovis there.

VERMEIL provides a list of his findings of Bulinus in the Fezzan in the spring of 1951, and of NASTASI (in parentheses) for the summer of 1937, together with the infection of the population in percentages (see Appendix Table XIII).

When there is no Bulinus, conditions of life for the molluscs are unfavourable, and the Cl^- content is probably too high. Should there still be cases of bilharziasis in these places, they will probably have been imported. Bilharziasis intestinalis seems to be absent in the Fezzan — but there is the occurrence of Melania tuberculata near Brak and Limnaea ovata (FRANCHINI).

Near Brak the Italians began with the disinfection and were fairly successful. The wells were protected, Pumps for deeper wells were installed and precautions taken so that the drilled water which rose up did not come into contact with infected water. In spite of cementing the artesian wells of Maharuga were not rid of infection. Small Biomphalaria were still found by VERMEIL. Cemented and uncemented irrigation channels alike must be cleaned frequently as the molluscs like to accumulate under stones and plants in running water. In the gardens themselves snails are said not to prosper, but for the purpose of manuring faeces are added to the water in which the farm workers wade.

On the whole older crater and funnel shaped wells in the *Fezzan* as well as the shallow cylindrical ones are easily accessible for children as well as others. This is the reason for their being infected like the small ponds near Traghen, the shallow, funnel-shaped wells at Hammera where 25 per cent. of the molluscs have cercarrae, and the easily accessible ones at Tmessa. Crater-like wells with algae and plants covering the walls too, harbour plenty of Bulinus in the organic mud, as is the case at Jerma (Wadi Adjel), while the wide wells near Grefa, which have been excavated in clayey-limestone soil and do not have organically decomposed mud below their steep walls, are free from Bulinus as is water with over 0.3 g. Cl/litre. Thus Edri, the water of which contains 0.37 g. Cl/litre, is free from Bulinus and its inhabitants from bilharziasis, as are Wenzerik with 0.6 g. Cl/litre in its water and Bergin as well. The occurrence of the disease in this western part of the es Shati is limited. The population and in the first place the children, will therefore have to be trained not to soil the wells, to stop urinating in the vicinity of water and not to bathe there. Old wells must be filled in. The Fezzans themselves blame the hot sand for causing the disease.

In *Tripolitania* intermediate molluscs of bilharziasis were found in some places, but it remains doubtful whether any infections originated from there. ZAVATARI observed Bulinus contortus in a small watercourse near Dersh and Tgutta. The snail is also said to live in the Rumia Springs near Jefren as well as in the pool of Farga near Jado. It is, however, doubtful whether they still exist in the Ain Zara area near Tripoli as was earlier observed before the Italians drained the swamps. In the event of their still living there, a possibility of infection would exist as the caravans to and from the Fezzan used to assemble there. In the infected swampy areas of Tauorga only Biomphalaria alexandrina (Planorbis boissyi var. libyca) and Melania tuberculata but no Bulinus. Nearly all the cases treated in the hospital at Tripoli as well as those occurring among Italian troops had had a period of residence in the Fezzan, so that infection had taken place there (SCADUTO, 1937). Cases from the wider environs of Tripoli as well — for example the six cases from Zliten, amongst which there was a mild case of intestinal bilharziasis (CICCHIOTTO) in 1932/33 — must be considered as introduced. The increase over the last years must be accounted for by increased emigration from the Fezzan to the coast.

Already in 1916 some cases of bilharziasis among soldiers had been recorded in *Cyrenaica*, and they could only have been infected in the country itself. A little later haematuria without fever or significant pain, together with the ova of the Schistosoma haematobium were found in the urine of herders from the Um er Rezzem wadi (south of Derna). During the search for the intermediate hosts, some wadis were found to be infected by Bulinus contortus: the Derna wadi down from the waterfall at the Ain Mansur; the lower course of the Wadi Latrun; the vicinity of the Ain Mara and the Springs of Gubba and Psiara. It must be remembered that S. haematobium may possibly also use other molluscs (see above) as their intermediate hosts.

Schistosoma mansoni, occurring sporadically on the Mediterranean coast and centred endemically in the Nile Valley, has also been observed in Cyrenaica. There were several cases of intestinal bilharziasis. They appear, however, to have been brought in from Egypt like both the recent cases in the years 1954/55. KLUG (Derna) likewise, knows of only a few autochthonous cases of S. haematobium in the country.

There is still uncertainty in Libya whether Biomphalaria alone or possibly also Bulinus, can act as intermediate host to S. mansoni. In general the nomads of Cyrenaica appear to have somewhat larger numbers of infections, as is shown by the cases in Cyrenaica in recent years. Neither bilharziasis nor infestation with molluscs occurs in the Marada oasis, the Augila, Jalo, Jakhirra or Jahgbub oases, the lakes and wells of which are too saline as are those of the Kufra archipelago and those near Benghazi. The Jofra too, (Hun and vicinity) has too saline a water to permit the development of Bulinus.

The WHO intends to destroy molluscs in the areas infected by bilharziasis, together with the implementing of the programme to eradicate malaria. Wells and open waters are to be protected from renewed pollution by infected persons and by the flow of infected manure; pains are taken to cure those infected. As most of the places where molluscs live are known and as it is only a matter of small parts of the population being infected, this project may well be crowned by success.

2. Ankylostomiasis

Ankylostomiasis (Ankylostoma duodenale, hookworm-infestation) is one of the most widespread diseases of the world. Thanks to its high temperature and the high degree of aridity, Libya is not really well suited for the development of ancylostomes. BACCHELLI

(1937) assumes therefore that the worm was imported from Italy or Ethiopia. Lush cultivation in the oases with small rectangular fields, particularly for lucerne, conditions a milder temperature and, thanks to irrigation, also the humidity necessary for the development of ova deposited here with dung or the excretions of agricultural workers defecating outdoors. These people then wade in the infected mud with bare feet so that the larvae penetrate the skin. Certainly in the Fezzan as well, foci created by imported ova may be found. In Ben Gashir, south of Tripoli, there are cases of ankylostomiasis every year. The disease is spread to the area by ova (GIACOMETTI). Some isolated cases were confirmed by the Bacteriological Laboratory in Tripoli (1932/52 but not every year).

In Misurata isolated ancylostomes were found in children. SCADUTO reported a case brought in from Tunis, POLAZZO one from Egypt and there may also be foci in Cyrenaica, particularly in the Derna oasis where sewage from slums situated higher up-slope flows into the irrigation trenches.

3. Cestodes Infestation

Where taeniasis (Tapeworm-infestation) in Libya is concerned, the following types occur: Taenia saginata, Taenia solium and *Echinococcus* which occurs among dogs; the eggs of the latter penetrate the intestinal walls of man and beast and get carried into the liver and other organs where they form a tumour consisting of large vesicles. Sheep and cattle are especially afflicted by cysticercus. The infection is picked up on the grazing land. Some cases were confirmed almost annually by the bacteriological laboratory in Tripoli during the period 1939—1952. In Tripoli the inspection of meat is carried out strictly; it is done less strictly in the country where great numbers of cestode larvae have been diagnosed in lung and liver, even in brain and eyes, almost every month and not only with Libyans but also with Italians (GIACOMETTI). Dogs are much infected with Echinococcus. These tapeworms are found with about 60 per cent. of all herders' dogs, ten per cent. of the town dogs, the larvae of which have been found in 40 per cent. of the sheep, 70 per cent. of the cattle and 20 per cent. of the pigs (CICOGNA, 1961). In the Government Hospital in Tripoli, 57 cases with infections of tapeworm larvae were treated over the period from 1951—61. In the Government Hospital at Benghazi, DOGLIOTTI confirmed cysticerosis in 20.2 per cent. of the patients of the dermatological ward in the year 1960, in 28.2 per cent in 1961, in 26.75 per cent. in 1962 and in 22.87 per cent. of the patients there in 1963.

4. Other Helminthiases

Helminthiasis is widespread in Libya. Worms when occurring in man in high numbers, often cause anaemia and eosinophilia. Helminthiasis is reported everywhere and is found with 17—19 per cent. of the patients in Benghazi (DOGLIOTTI); at Jado, Jefren and Gharian on the Jebel, ANGRISANI found helminthiasis in 90 per cent. of all people examined (1953). In the Fezzan, Trichuris, Enterobius (pinworm) and Ascaris (giant intestinal roundworm) are widely spread. An examination in the primary and Koran schools at Misurata, Sirte, Zliten, Nofilia and Tauorga in eastern Tripolitania 70—75 per cent. were reported to be infected by ascaris alone. In 1935/36, TRIPODI proved that 50 per cent. of all patients were infected by ascaris, 15 per cent. by Trichuris trichiura, 2 per cent. by Taenia saginata and 0.5 per cent. by Hymenolepis nana. The larvae of Ascaris lumbricoides wander through the lungs and are found in large numbers with children. Trichuris causes intestinal complaints, especially in children. At times, at least in former years, the guinea worm had been said to have been imported from the Sudan (NACHTIGAL).

There are scarcely any Trichinella spiralis, because Moslems do not eat pork.

V. Anthropozoonosis and Zoonosis

1. Brucellosis

Two kinds of *brucellosis* are known in Libya: *Malta or Mediterranean fever* and the *Bang disease*, the bacteria of which, Brucella melitensis and Brucella abortus, do not require intermediate hosts but are transmitted by touching the excretions (milk and urine) of goats, sheep and cattle. In the case of cattle, the genitals, too, are infected (Bruc. abortus Bang) and miscarriages occur. As for man, the infection manifests itself by undulating fever and conditions similar to rheumatism.

Presumably the disease had already been endemic in Libya before the arrival of the Italians. VIGLIETTA refers to eight cases in the period 1920—1933, which concerned Italians only; he did not consider them to be autochthonous but to have been caused by cheese imported from Italy. But in 1936, TRIPODI mentions that melitensis fever was widespread in Tripolitania and the bacteriological laboratory also confirmed a few cases each year (1939—52) with something of an increase in 1939 especially (98) and 1946 (90).

In Cyrenaica, MEDULLA (1931) recorded melitensis fever in the city of Benghazi, in the southern part of the Benghasino and in the vicinity of Barce, while Morbus Bang did not occur among local cattle. Then, according to VIGLIETTA, there was a kind of epidemic in the eastern part of the Jebel Akhdar (Derna Province) in 1934. Nineteen per cent. of all goats and 17 per cent. of the sheep were infected by Brucella melitensis and the disease accordingly occurred among man in various places where they lived in close proximity to their livestock. VIGLIETTA attributes the spreading of Brucella melitensis to the import of infected herds from Tripoli and Sicily and herds imported from Egypt, the medical examination of which produced a negative result in August, 1934, may have contributed to the spread of the disease in earlier times and thus to a hidden immunity of the indigenous population. When sheep were imported from Malta in 1953, another epidemic broke out (GIACOMETTI). Even nowadays there are still isolated cases in Tripolitania and Cyrenaica (see Table XIV 1959—63).

2. Q-Fever

Q-fever, the germs of which (Rickettsia burneti) live in cattle, goats and sheep, is transmitted to the animals by ticks (Ixodidae). Animal products like milk and urine pass it on to man, as does the touching of the afterbirth and probably also air-borne by droplet infection

and dust. Q-fever as an epidemic outbreak has only been known since World War II, and at first exclusively among the troops, reaching a morbidity of up to 53 per cent. Peaks in the outbreaks were recorded with German and Italian troops in 1941 and again in 1945 among the post-war troops of British and American formations. There are no reports of outbreaks among the Libyan populations. Considering the density of the goat and sheep population, the majority of the inhabitants may well be carriers of anti-bodies; moreover, the clinical representation shows few characteristics, so that mistakes are possible.

3. Anthrax

The anthrax bacillus (Bac. anthracis) is introduced to the pastures by the faeces and blood of infected animals. Here as well as in the blood of dead animals, spores are formed which prove extremely resistant to heat and cold, aridity and humidity. The spores are picked up by sheep, cattle and horses on the pastures and thus the bacillus is spread. Skin anthrax, ranging from small pustules to deep carbuncles, is not too rare a disease in Libya, while anthrax of the spleen hardly ever occurs (KLUG). On the Tripolitanian Jebel (Jado, Jefren) anthrax of the skin was noticed several times among skin collectors (MEINCK). Among 2,000 dead camels only one case of infection was found.

4. Rabies

Rabies is an epidemic disease affecting mammals only, and of these again only the carnivorous ones. In Libya, the jackal, hyena, fox and dog become infected. At times transmission to all mammals, even the herbivirous ones, may occur, but like man, they present the final stage and not the origin of the epidemic. In the desert areas the disease loses its importance.

Herding dogs in Libya cannot be kept in kennels; moreover, there are numerous stray dogs in the settlements. As a result there are also a few cases of rabies among man every year (1939—1952, Bacteriological Laboratory, Tripoli); see Table XIV covering the years 1939 to 1952. In a period of ten years, KLUG observed eight fatal cases in Cyrenaica. Attempts are being made to fight the disease by vaccinations of men and dogs.

5. Zoonoses of Domestic Animals

In Libya the domestic animals suffer, from a great number of infectious diseases, some of which have been introduced. As some of them are highly contagious, man, too, must take precautions. The spread of diseases and the death of livestock may cause severe economic damage. The most important diseases are to receive a short mention (PRICOLO, ALONGI, BALBONI, ZAVATARI, FRANCHINI).

Afta epizoica (thrush) has been imported. It has not been encountered among native cattle; the danger of spreading is small. There have been ten cases of *morva* but it is uncertain whether it is endemic or imported.

Pleuropulmonitis, affecting horses and cattle, is imported. A pulmonitis epizoica is said to strike goats. Against swine fever strict measures have been taken to avoid its spreading in Tripolitania. There is no *rinderpest* in Libya but there is danger of its being imported together with cattle from Italy. *Tuberculosis* is rare among natives' cattle. At the autopsies of 500 camels none was found. There are various kinds of *scabies* affecting camels, horses, goats, sheep and cattle.

The usefulness of animals and their products, especially in the case of camels and sheep, is reduced; at times there is loss of these animals. The damage incurred by the epidemic can thus be considerable.

Throughout Libya *trypanosomiasis* of the camel (Surra, debab, slael) is found, caused by Trypanosoma evansi (syn. sudanense). On the coast also that of horses, cattle and sheep. The animals grow very thin. Horseflies and ticks act as transmitters of this disease as well as of piroplasmosis, spirochaetosis and filaria larvae which live in the blood of camels. As for *parasites of the intestines,* trichuris and strongyloides are found as well as Dictyocaulus filaria and Protostrongylus rufescens with goats, while distomatosis is rare. Echinococcosis and cysticercosis are frequent with camels, goats, sheep and cattle.

Canicola *leptospirosis* together with jaundice and leptospirae in urine filtrate was recorded on five occasions in 1941, just as spirochaetosis of chickens and brucellosis. Other diseases are dourine of donkeys and a verminous pneumonia of sheep.

VI. Non-infectious Diseases

1. Diseases Connected with Pregnancy and Birth

In Islamic countries girls are married off early; they are expected to be virgo intacta when contracting the marriage. The father and later on the husband, decide on a woman's life, the former determining the date of marriage and the prospective partner. FÖLLMER was able to observe that one third of the girls in Libya were married before beginning to menstruate and that the marriage was consummated then. No physiological sterility was observed to occur during the first years after the initial menstruation and it became obvious that the Arab women by no means matures earlier than her European counterpart. Within the first year after the onset of their first menstruation the majority of women become pregnant. There were only a few cases of miscarriages among those under age; in the first two years after the commencement of menstruation, 89 per cent. of first pregnancies were carried for the full term. Women of all age groups experience premature births more frequently than do European women. Complications like toxicosis and hyperemsis gravidarum during pregnancy are rare. But there are frequent, at times serious anaemias affecting pregnant women, not only in the less developed interior of the country where malaria and bilharziasis are still endemic and intestinal parasites can frequently be found, but also in the coastal areas when these diseases occur only as imported cases. FÖLLMER suggests lack of animal protein in the diet as the cause. The opinion is confirmed by the investigations of FAO which discovered that the maximum intake of animal protein amounted to 10 g. a day and normally remained below this figure. Women and children do not take their meals together with the men but get what is left behind from their meals. Moreover, the protein metabolism of the women is burdened by continuous extraction of protein by continuous pregnancies and lactation. This results in a hypo-proteinaemia together with a lack of vitamins and calcium, which cause bodily complaints

of pregnancy. Intestinal complaints during pregnancy, against which charcoal is taken, aggravate the anaemias. According to the FAO, the daily intake of calories amounts to 2,000—2,300 calories per male and less for females.

As in many Islamic countries, so too in Libya, young girls between the age of seven and ten are circumcised by removing the small labium and part of the clitoris. Scars form and narrow the introitus vaginae with the effect that pains occur in coition as well as difficulty in their first delivery. Plastic surgery is necessary during the delivery in order to repair the consequences of this (FÖLLMER).

In Libya, domestic midwifery still plays a dominant role in deliveries. A large proportion of the midwives are untrained women. They often enter the vagina during the process of delivery by using oil or fine sand, frequently without knowing the basic rules of asepsis or the most basic obstetric manipulations. Out of 475 deliveries, 33 were aided by trained midwives, 14 took place in hospitals (= 10 per cent. under trained supervision), 47 without help or with nothing but the help of a neighbour. At all other deliveries Arab midwives without significant training were in attendance (1960). During the process of delivery, ruptures of the uterus may occur, due especially to the narrowing of the pelvis or to a previous caesarian operation, if the women goes through her following delivery in her village. Therefore any operation is preferable to the caesarian one, even if the child is in danger. Another serious complication is the premature parting of the correctly positioned placenta. FÖLLMER considers hypoproteinaemia to be again the chief reason for the frequent occurrence of these complications. As pathological deliveries occurring in Libya, FÖLLMER lists the following ones:

Table V. *Obstetrical Operations*

pelvic presentation	0.54%	Obstetrical operations:	
transverse presentation	2.08%	pelvic presentation	0.54%
haemorrhage ante partum (only the premature parting of the correctly positioned placenta)	1.54%	forceps delivery	7.00%
		version	1.08%
		embryotomy	1.43%
		caesarian section	1.43%
placenta praevia	0.72%		
haemorrhage post partum	—		
twins	1.08%		

Even in hospitals, during obstetrics the mortality of mother and child is higher in Libya than, for instance, in Germany. According to FÖLLMER and BRACALE it amounts to the following:

	maternal mortality:	*still births:*	*perinatal mortality:*
Libya	2.6 %	31.0%	108.3% (half of which are premature births)
Germany (1958)	1.16%	16.4%	21.1%

2. Infant- and Child-Mortality

Infant mortality is much higher among those being delivered at home and away from the towns. As mentioned above, there is still much room for improvement as far as obstetrics is concerned. Moreover, there are infections of the navel caused by unclean knives, wood or stones which are used to crush off the navel-cord. Dirty bandages or strands of the mother's hair are used for ligation; the wound is treated with sand and loam, the babies are bathed in sand. Neonatal tetanus is bound to occur (see Table VII).

Table VI. *Natality and Mortality in Tripoli town*

	1958	1959	1960
Natality per 1,000 inhabitants	18.4	23.3	23.4
over all mortality per 1,000 inhabitants	17.1	17.5	19.2
infant mortality per 1,000 life births	375.4	292.6	359.5
still births per 1,000 life births	134.3	113.9	98.5

Of 100 women between the ages of 17 and 38, who were questioned about their children (FÖLLMER, 1962), the following information was received:

Pregnancies carried to full term	miscarriages	children born alive	still born
475+9*	42	272=56.2%	203+9*=43.8%

Death occurring between 1—12 months of age	1—5 years of age
150=30.9%	62=12.9%

* twins, one of them died

The weight of children at birth remained below 2,500 g. in the case of premature birth, but reached 2,500—4,000 g. with normal births, the average being about 3,000 g. All prematurely born children died as a result of inadequate care. Young mothers had the largest numbers of prematurely-born children (FÖLLMER):

16 year olds	17 year olds	18 year olds
21%	16.7%	19.9%

These percentages have now been greatly reduced thanks to pre-natal care and the advice given at mother and child health centres.

The further growth of the child depends on its *nutrition.* At first it is given mother's milk. If there is not enough milk from the mother herself, the child is handed over to another female member of the family to be nursed. If no mother's milk is available anywhere, it is fed on cow or donkey milk, and at that point the first nutritional disorder occurs as the necessary dilution of the milk is neglected or performed incorrectly, and the child is fed too frequently (every three hours). Thus the child is as it were drowned by milk (protein-poisoning, ANGRISANI, 1953). If there is not sufficient mother's milk, as for example when another pregnancy has occurred, food from the adult's table is given. This may happen already at the age of two months only, although six months is the rule. These meals consist of maccaroni, cuscus with pepper, tomato-puree and vegetables, all of which these children are unable to digest (SELBY-LOWNDES). Diarrhoea with vomiting and dyspepsia are the result. Until the end of its second year the child is chiefly fed on carbohydrates and only insufficient amounts of animal protein which are taken in with the mother's milk. This explains the inadequate weight increase, the symptons of protein deficiency and the reduced resistance against infectious diseases (flies, dust) and also the high mortality of 50—60 per cent. of children born alive during the first five years.

It has been estimated that every year 5,000 children die from infantile gastro-enteritis, mainly in larger settlements during the months of June to September (gastro-enteritis acuta, enterocolitis acuta, dystrophy). Eye infections, transmitted by dust and flies also often take a fatal course with small children.

When examined, tensions in the stomach area were frequently found, once even a distinct tumour at the pylorus, the size of a small apple. As I did not carry a large stock of medicines with me, I advised the patient to forgo the pleasure of boiled tea, at least to omit the first brew, which I could not easily take myself, and I

Table VII. *Infant Mortality*

a) Causes of death for children under 1 year of age (FÖLLMER):

death during or shortly after birth	premature birth	nutrition insufficient milk	tetanus under 1 week	tetanus older than 1 week
12 = 8%	19 = 12.2%	25 = 16.7%	37	4
			= 27.3%	

enteritis dyspepsia	infections of lung; measles	accident	unknown causes	deformities
18 = 12.0%	20 = 13.8%	3 = 2%	10 = 6.7%	2 = 1.3%

b) Causes of death for children older than 1 year of age (FÖLLMER, *1960*):

nutrition	intestinal infections (flies)	other infections	circumcision	accident	unknown causes
4 = 6.5%	23 = 37.1%	22 = 35.5%	2 = 2.3%	1 = 1.6%	10 = 16.1%

3. Non-infectious Children's Diseases

On the whole the non-infectious diseases of older children are the same as in Europe. Therefore only most important ones will be mentioned. Older children, too, are frequently still suffering from the results of malnutrition and undernutrition. Amoebiasis is frequently found; leishmaniasis with splenomegaly often occurs in children of the two to six year old age group. Tuberculosis and rickets are not rare. Differences in temperature in autumn and winter together with the increased humidity, often brings cold, coughs, angina and bronchial catarrhs. Pneumonia is said to be rare and hardly occurs at all in the dry desert (as BARTOLI reports from Kufra). Continuous colds, due to sleeping on the cold ground, are the causes of rheumatism which occurs relatively frequently, which in turn is often followed by heart diseases and arthritis as well as chronic nephrosis.

4. Non-infectious Diseases of Adults

Bites by scorpions are a danger for all young people; fatalities occur every year. *Snake bites* are rare. My guide (50 years old) had once been bitten by a horned viper when collecting wood and never quite recovered again in spite of the immediate application of home-made remedies, followed by a serum injection shortly afterwards.

Syphilis infections often play a role in the formation of *heart diseases* and *circulatory disorders.* A further result of syphilis is *cirrhosis of the liver* which is said to occur fairly frequently, just as does occlusion icterus, particularly after disorders of the stomach and intestines. As for *diabetes* patients, an antidiabetic centre with 100 beds has been set up in the Government Hospital in Tripoli in 1960. Koprostasis and haemorrhoidal complaints are often caused by the misuse of filfil (pepper), tea and coffee.

In the Kufra oases and in Tibesti the indigenes often complained about pains in the stomach region. supplied him with Pansedon to last several days. This therapy always worked. Even the tumour patient, who I saw again six weeks later, cheerfully told me that he was healthy once more. Indeed, the tumour had disappeared completely.

Except for trachoma, still frequently encountered, non-infectious *eye diseases* among adults are the same as those in Europe.

Where non-infectious *skin diseases* are concerned, the aihum are to be mentioned; atrophies, hypertrophies and degeneration of the extremities, especially when injuring the naked feet when doing garden work, occur but seldom. Three of them were witnessed by GIACOMETTI in the vicinity of Tripoli over a period of 15 years. Isolated cases are said to have occurred among Negroes in the Fezzan. Five cases have been reported from the Jebel Nefusa (ANGRISANI).

Only a relatively small percentage of eczemas like dermatitis intertriginosa, erythroderm, damp and dry varicoses and seborrhoic eczemas (BERTI) are found among the Libyan population.

5. Psychic Disturbances and Mental Diseases

In the Government Hospital in Tripoli, about 500 to 600 patients — a figure continuously fluctuating — are treated in a year (GIACOMITTI). Hysteria among indigenous and also with Italians is frequent; at times it is linked with the hot Gibli and often linked with attacks of an epileptic nature which can also be caused by annoyances. In addition the psyche is often influenced by superstition (ghosts, evil eye) and by malevolence which may lead to violent outbreaks (psychosis) under the continuous strain during long caravan journeys. Syphilis, too, often causes psychosis, tabes (lues cerebri) and paralysis. Various diseases may cause polyneuritis with peripheral paralysis.

Table XIV provides an official list of infectious diseases from 1959 to 1963. It must be noted, however, that these are diagnoses made when patients are admitted.

E. Region and Disease. Geomedical Conclusions

The Libyan area has been divided into 26 regions, differentiated according to the nature of their surface and of their climate and thus also of their hydrological conditions and their plant-cover. Except for small sections of the population, the inhabitants of the country are of one uniform culture and live in the landscape component parts most suited to their needs, some of them as farmers or townspeople in consolidated settlements, which means close to one another, others scattered over the country as semi-nomads, often linked with a permanent settlement but in the main wandering around in order to make use of the less favourable regions. Today only a small section of the population may be considered as pure nomads. A number of regions are scarcely utilizable and are therefore devoid of people, so that in comparison with the size of the country the population lives only in a few regions and again chiefly in smaller sub-regions of these.

The enormous scale of the area, the long distance between individual settlements and the still difficult communications, all play a part in determining the condition of health of the population. It is a country that does not encourage the rapid spread of epidemics. On the other hand, general conditions of health are impaired by endemic infectious diseases, above all by "*nestling epidemic diseases*" (JUSATZ) which are at home in the region independent of man and transmitted to man by insects, water and/or foodstuffs. The question which arises here is in how far a dependence of these diseases, as for example in the cases of malaria, the leishmaniases, dengue and others, can be attributed to the regions in Libya.

It is known that there is dependence of that kind in the case of *malaria* for instance, as there must be water at particular times in the spring for the breeding of those kinds of anopheles which act as carriers where the eggs are laid and larvae are able to develop. Some larvae are conditioned to fresh water while others can also prosper in brackish water. It is of importance for the individual species whether the water is stagnant or running, whether it is situated in sunlight or in shade. Anopheles maculipennis, for example, prefers stagnant sunny waters with temperatures between 22° and 29° C. In the coastal areas of Libya and in the Fezzan, too, the groundwater mostly reaches relatively high levels in the wells, rising to the surface in pools in the sebkh and in swampy flats between the dunes. As a result of irrigation, cultivation water often remains in ditches and furrows in gardens and fields for longish periods. Strong rains often leave puddles behind and at the mouth of deviated wadis ponds and lakes form behind strand banks. In the leaf axles of palm fronds water accumulates as well. Protection from too rapid an evaporation is afforded by various plants and especially so by rushes and reeds. Thus there is usually sufficient water available at the start of spring to last the four weeks the larvae take to develop. Towards the end of February the young begin to sting. If the female ones become infected when sucking blood from men who harbour sexual cells of the malaria plasmodia in their blood, it takes another three weeks for the plasmodia to mature. This happens, however, only if the temperature does not fall below 16° C. Only then is infection of man made possible. The stinging season lasts from the end of February to the end of November, autumn being the time when most fresh cases occur in Libya.

During the winter the mosquitoes withdraw to the dwellings of people and even during the warmer months they like to spend the daytime hours in dark corners there. In the absence of such they hide in cracks in walls, in palm-leaf fences and plant thickets. The mosquitoes always require a certain degree of humidity in the air — too hot, dry weather easily kills them off. For that reason swarming and stinging only occur in the evening or at night.

Those conditions favourable to the requirements of the anopheles are to be found in the coastal areas of Tripolitania, shown on map 3 (1 a_2 and $_3$, 2 c_1, 2 f, 4 b_1, b_2) and in the malaria areas entered as such. According to this, the Zuara area must be considered as not being infected, although there are extensive sebkh in the immediate vicinity which are rich in water in springtime and wintertime. It may be that the water contains too much salt hereabouts, especially as some of the sebkh are connected with the sea. The coast between Tauorga and Benghazi (4 e, 14 a and d_1) appears to be free of malaria also, although here, too, sebkh, lagoons at the wadi mouths and dwarf-shrub steppes are to be found. Thus the conditions for the development of mosquitoes are favourable and GHISLERI (1912) describes this Sirte coast as ill-famed for malaria fever. Indeed, except for some small settlements and tent-places of nomads, the entire sub-region is as good as unsettled and the chance of infection is much reduced in consequence. In recent times three oil exporting ports have been growing up on the coast, where, unless sufficient care is taken, stronger infection may be brought back to a place where it obviously existed in earlier times.

This would also endanger the low dissected plateau adjoining in the south (4 d) where, due to blocking up, the wadis flowing off to the coast form swamps at times. Malaria might be transferred and spread into this area, which is visited by numerous nomads from surrounding oases (especially Zella and its vicinity). In this instance, a geomedical prognosis can be made which demonstrates the importance of the geo-factors soil, water and climate very well indeed.

In the east the environs of Benghazi with their lagoons, collapsed, water-filled dolines, were infected until the environmental conditions were improved by the Italians, just like the coastal strip as far as Apollonia (15 a_1). In the contiguous part extending as far as Derna, malaria is probably still present at the present time (1965) as mosquitoes still live in some of the perenially flowing wadis which contain ponds, lush vegetation, lagoons and lakes at their mouths close to the small settlements. To the east, towards Tobruk, the coastal climate becomes drier, the country poorer in water and settlements with the effect that, despite the possible existence of anopheles in places, infections may hardly be expected.

From the coast to the interior the climate becomes gradually both drier and warmer, humidity and rainfall totals decreasing. Only at the foot of the Tripolitanian Jebel (2) which has somewhat higher rainfall, lies the now re-constructed spring-line previously mentioned (1 d_1). Here, just as it does from the heights of the Jebel

Akhdar, rainwater runs off rapidly or seeps in. Only in a few places have insignificant swampy areas formed in the vicinity of isolated springs.

In the full desert, the arid climate suits the mosquitoes even less and the oases have nothing but brackish water at their disposal, which salinizes the soil gradually through irrigation cultivation. Where there are natural and newly-drilled artesian fresh-water wells (Gadames), the danger of a new infection of malaria increases with the amount of water. The Jalo and Kufra oases are situated on the edge or within the total desert. As they have only saltwater lakes but relatively few wells, anopheles which transmit malaria scarcely occur.

In the Fezzan, climatic as well as hydrological conditions are better suited to the mosquitoes requirements. There are numerous fresh water wells and irrigation channels and the individual oases of the long wadis are not too far from one another, so that busy traffic is possible. In the areas free of malaria the oases are poorer in water and are further away from one another (Hofra es Shergia, southern Wadi Hecma). The Italians probably re-constituted the small spring-pools near Sebha but did not succeed in doing so in those parts of the es Shati and Adjal wadis which were well watered.

To demonstrate a further example of how the spread of diseases may be influenced by geofactors, *leishmaniasis* and *pappataci fever*, which are transmitted by phlebotomes and live in a way similar to that of the anopheles, should be mentioned. As humidity is a condition for their development, they breed at the walls of ditches and canals and also in humid, decaying organic matter or in the holes of wild rodents. About 60 kinds of phlebotomes are known, only a few kinds of which transmit skin leishmaniasis, others visceral leishmaniasis. Transmission takes place mainly from one animal to another, man appears to be nothing but a subsidiary host. In Libya leishmaniasis has been observed with dogs, cats and rodents. Phlebotomes must exist if transmission to humans is to take place.

In the arid transitional areas towards the Sahara, phlebotomes are no longer encountered. In Algeria it was found that it does not cross the 30° N. parallel towards the desert. This limit is probably valid in Libya as well, but exact data are missing.

Aedes aegypti, the mosquito which transmits *dengue*, endemic in the eastern part of the Mediterranean area, prefers hot summers but humid, mild winters for its development. In Libya, this mosquito does not live at heights exceedings 600 m. Thus the area where it occurs in Libya is confined to the narrow strip of the Mediterranean coast. Aedes is a modest domestic mosquito, perfectly adapted to man, even if sucking blood from mammals, birds or even cold-blooded animals, but without infecting them. Its breeding places may be found everywhere where stagnant water occurs — rain gutters, open wells, irrigation ditches and empty, discarded tins. Here the eggs experience their 10—14 day process of development, but are equally able to last out several months when the water dries up, in order to hatch immediately the first rains fall. At climatically favourable times, as a winter with high relative humidity of the air, there may well be a mass break-out of mosquitoes. If followed by hot summers with a great increase in the mosquito-population coupled with the existence of virus carriers among the people, dengue epidemics are likely to occur. Therefore the entire Libyan coastal strip must be considered potentially endangered.

Bilharziasis is yet another endemic disease greatly dependant on the environmental conditions. Bilharziasis can only occur in places where there are conditions favourable for the life of its intermediate hosts, molluscs of the planorbid family; that is stagnant or slowly moving shallow waters not exceeding a certain percentage of chlorine (for example, not more than 0.3 g. Cl/litre for Bulinus contortus). If no intermediate hosts are available, no fresh infections can occur, only imported ones.

The great area of endemic bilharziasis in Libya lies in the Fezzan. Here the molluscs live in open wells, geltas, irrigation trenches and artesian wells. The infected population and above all the children, keep polluting the water and thus spread the disease. The Wadi Edri and its vicinity, the Grefa Oasis (Wadi Adjal), Um el Araneb and Zuila are free from molluscs and the disease. The water has too high a salt content or there are only a few wells as drinking water is in short supply.

The oases situated north of the Fezzan are equally unsuitable for the development of the molluscs; only in Dersh and Tgutta were they found. Gadames appears to be free from it, probably owing to the fact that the Ain el Fras, the big artesian well, is walled in and kept clean. The newly drilled artesian wells might possibly present a further risk, especially if the quantities of water running off result in permanent accumulations of water.

In Tripolitania the coastal area around Tripoli has always been endangered, formerly by caravans which used to rest near the swamps — since drained — at Ain Zara, and nowadays from the Fezzan, living in shanty towns on the outskirts of town, many of which brought the schistosoma with them. Favourable conditions for infections exist along the entire coast from Zuara via Zliten, a place of pilgrimage (2 f) to Tauorga (4 b_1) and further along the Sirte coast (4 e, 14 a and d_1).

When searching for the intermediate hosts in Cyrenaica, after nomads from Um er Rezzem wadi had been found to be infected, it was confirmed that wadis with perennially flowing water (Derna wadi, Latrun), the vicinity of the Ain Mara, those of the Gubba and Psiara Springs on the plateau, harbour molluscs. A spreading of bilharziasis might occur from here through the agency of nomads who appear to be more strongly infected than had been hitherto assumed.

The oases of Marada, Jaghbub and of the Jalo and Kufra archipelagos which are situated in the south, are free from the disease, as remoteness and much brackish water probably prevents the colonization of molluscs.

Thus the infection of Libya with schistosomes is rather confined, the limits of which are drawn by increased salt content in the water resources of several oasis areas.

This example shows in a most convincing manner the importance of the geofactors water and soil for the epidemiology of a country.

We know the *shifting epidemics* (JUSATZ) as opposed to nestling epidemics, which are related to the region independently of human agency. In an endemically infected area with sporadically occurring cases, isolated foci of the latter come into existence according to climate and soil, the development of the pathogenic agent and of the transmitting vector, from which the epidemic outbreak concerned may be exported and spread by man

or animal. Geo-medical conditions in Libya enable shifting epidemics to cover a large area. A few examples may help to illustrate this.

Cases of *typhus caused by rickettsiae* for instance, chiefly occur during the cold season, when warmer clothes are worn and kept on the body during the night as well. This humid microclimate of the human body, averaging between 31.5 and 33° C., suits the transmitting lice remarkably well. They then deposit their eggs (nits) which remain on the body hair and clothing. Five to six days later the young lice hatch. The warm, dry season is less favourable to the lice as the humans are then wearing light clothes and the lice are exposed to high temperatures and insolation. In areas classed as grade II as far as hygiene is concerned (according to v. BORMANN in the World Atlas of Epidemic Diseases III, p. 67) (insufficiently hygienic way of life), to be met among the nomads in Libya in Cyrenaica and especially in the Fezzan, there are small epidemics almost every winter with fatal results among the children particularly. Most children, however, become immunized for life. The epidemic of the period 1938—46, which appears to have originated in Gharian (map. no. 14) will be taken as an example to illustrate the participation of the nomads as transmitters of the disease.

Lice as well as certain kinds of ticks also spread borreliae which cause *relapsing fever.* Sporadically occurring cases in northern Africa leave the question open on whether the fever is to be considered as caused by lice or by ticks. Louse-borne relapsing fever is the European form and also occurs occasionally in North Africa and in tropical highlands. Ticks (Ornithodorus) as domestic pest live in clefts and cracks of houses and in sandy soil. Borrelia may remain virulent in the ticks for years and even transfer from infected ticks to the eggs, which are laid in the soil in dry places. Transfer occurs between rodents and man via the ticks and vice versa, as well as from man to man. The indigenous population acquired a high degree of immunity against the disease.

In the transitional areas of the countries of the arid climatic zones and in the oases of the desert, lives ornithodorus far from man in the holes of rodents, foxes and rats and infecting them. Consequently these areas must be regarded as *permanent foci* for this spirochaetosis which does not therefore seem to be exterminable. Men become infected when sleeping near the holes of rodents, or on a tent-place, in a cave or well infested by ticks. The nomads in turn bring the ticks to relatives and friends or they are carried off together with the camel bales as happened (see map 14) in 1942 to 1944, when the disease advanced, probably via Murzuq-Bergin, to Tunis, Algeria and even further with the caravans then operating. In 1933, too, nomads brought the disease from Cyrenaica to the Sirte. There was an epidemic in the city of Benghazi; in 1911/12, an epidemic swept through the city of Tripoli.

Finally *plague* should be mentioned as a shifting epidemic, although really it ought to be considered a nestling disease. In the course of centuries, plague was imported again and again into Libya from overseas or by land routes. Epidemics in towns can generally be traced back to infected rats, which, originating in the ports, infected the rats of the towns and thus the people, too, with their fleas. From here the urban form spread, carried by the semi-nomads, to the rodent fauna of the steppe and semi-desert, thus leading on to the infection of large areas where small epidemics (rural form) occurred in native settlements. Again, rodents are probably responsible for spreading the disease from the large Egyptian focus to Cyrenaica. The urban epidemic from 1917—22, is said to have been imported by caravans from Egypt to Benghazi, with human fleas transfering the disease from one man to another, and he in turn passing it on to domestic animals. It should, however, be noted here that rural epidemics (1915—16) occurred in the immediate vicinity of the towns of Tolmeta and Barce, while communications between the country and these towns continued, so that an infection of the city of Benghazi from here could easily take place. In Cyrenaica the epidemic came to an end in 1922, yet, smaller endemic foci continued to exist among the nomads and semi-nomads for some years after.

Conditions in Tripolitania were similar, with the sole difference that plague came to an end in the city in the year 1921, and in the surrounding country smaller rural foci kept flaring up until 1940. There does not seem to have been an overland connection between the Tripolitanian and Cyrenaican foci. Fleas as well as their larvae are very sensitive to extreme aridity; they require a certain degree of humidity. The further towards the desert they find themselves transported, the more they are affected by aridity and the more does their mortality rate increase (BODENHEIMER, E. MARTINI). The Sirte areas seems to present a border zone for them just as the total desert prevents the fleas from advancing further to the south and thus taking the disease into the Fezzan. As motor vehicles increase in numbers, this desert boundary can be crossed more easily and fleas may well spread on the rodents of the oasis should plague enter the area once more as a shifting epidemic.

The nomads, who played a role in the spreading of typhus and relapsing fever, act indirectly also as the spreaders of *zoonoses.* Their flocks of goats and sheep have been infected by livestock imports from Malta, Sicily or Egypt. Together with the secretions of infected animals, the brucelloses are spread on the pastures; humans become infected by milk products. Exactly the same happens in the case of Q-fever, which is transmitted from one animal to another by ticks. The nomads have acquired a certain degree of immunity against these diseases.

Conditioned by regions and culture are the *diseases associated with low standard of hygiene* which are transmitted by contact from one person to another or by flies. Bacterial eye diseases and trachoma may serve as examples. The former are especially widely spread in the desert oases where temperatures rise high in summer and flies are around in great numbers. Particularly dangerous therefore is autumnal conjunctivitis at the time of the date harvest, and the kerato conjunctivitis in connection with malnutrition especially Vitamin-A-deficiency and social misery, which in turn favour the spread of chronic trachoma.

Pollution and infection of the soil by inadequate sewage conditions, together with high temperatures, speed up the development of worm eggs. This is the case especially in those irrigation oases where either faeces are added to the water for the purpose of manuring or liquid

manure from the neighbourhood happens to flow in. Thus soil and water alike may easily become infected by amoeba cysts which then pass into the human by way of drinking water and foodstuffs. The same causes lead to further spreading of dysentery and typhoid bacteria in the irrigation oases, if such bacteria have previously been imported there or if there are permanent carriers among the population.

These few examples of infectious diseases show that the health service fighting them must not only consider the conditions of life of the germs concerned but also take into account the specific conditions of the region in which the vectors live and on which they depend, if the attempts to control them and to improve the health conditions of the population are to be successful.

This study of an area, which due to its regional configuration is still largely of an original character, according to a geo-medical viewpoint, is likely to be taken as an example of the necessity of considering the interaction of the different factors of a region where the epidemiological conditions of the spread of a disease in a particular country are to be brought to light.

Progress in the field of improving the conditions of life of a population will come about the sooner geo-ecological relationships are elucidated, observed and any action taken based on the necessities indicated by them.

Anhang / Annex

Tabellen zur Bevölkerungsstatistik / Tables of Demographic Statistic

Anmerkung

Die Daten über die Bevölkerungsbewegung in Libyen sind, soweit es sich um die älteren Angaben handelt, nur annähernd richtig, wenn sie zum Teil auch von feststehenden Zählungsergebnissen abgeleitet sind, die zu den endgültigen Schätzungen verwendet wurden. Reguläre Zählungen (Zensus) wurden 1931 und 1936 von den Italienern, nach dem Kriege zum ersten Male wieder 1954 mit Hilfe der Besatzungsmächte durchgeführt. Die Bearbeitung des Materials unterblieb ganz, besonders da geschultes libysches Personal noch fehlte, bzw. ließ lange auf sich warten. Die zweite offizielle Zählung erfolgte 1964 schon nach den neuen Provinzen geordnet (s. Karte 13), um eine bessere Grundlage für die Wahlen zu erhalten. Diese Ergebnisse sowie die der früheren italienischen Zählungen und Schätzungen sind zugrunde gelegt, um ein annäherndes Bild über die Entwicklung der Bevölkerung zu dem jetzigen Stand zu erhalten.

Bei den Zahlen für die Städte, besonders Tripolitaniens, ist es vielfach schwer zu entscheiden, wieweit die umgebende Oase noch dem Stadtgebiet zugeschlagen ist oder aber wieweit z. B. bei Misurata, Zawia und den Orten des Dschebels Eingemeindungen erfolgten. Klarer liegen die Verhältnisse bei den Städten der Cyrenaica.

Notes

Data on population movements in Libya are only approximately correct even if they do come from older sources, even if in parts from established census results which were employed for the final estimates. Counting proper (census) took place in 1931 and 1936 under the direction of the Italians, after the war again in 1954 with the aid of the occupation powers. The interpretation of the material collected was left undone or was at least postponed for a long period because no trained Libyan personnel were available. The second official census took place in 1964 and was conducted in terms of the newly-defined provinces (see Map 13) in order to ensure a better basis for the coming elections. These results, together with the earlier Italian counts and estimates have been used in order to obtain approximate information on the development of population up to its present state.

The state of Libya and each of the three countries will be considered separately. As for the figures for the towns and in particular those of the Tripolitanian ones, it is difficult to decide in how far the population of the surrounding oasis might be added to that of the town proper or how far the process of incorporation has proceeded in Misurata, Zawia and the settlements of the Jebel. The situation in the towns of Cyrenaica is much clearer. In order to provide a better overall picture of the pattern of population distribution, the latest figures (1964) of the provincial districts have been added, i.e. of the ten new administrative districts formed after the transformation of the united kingdom into a unitary state on April 27th, 1963.

Tabelle VIII. *Libyen* / Table VIII. *Libya*

Jahr/Year	Tripolitanien	Cyrenaica	Fezzan	Gesamt/total
1915	—	—	—	1000
1936	—	—	—	839,5
1954	738,3	291,2	59,3	1091,8
1964	1029,2	451,4	78,7	1559,3
Zunahme/ Increase	290,9 =39,4%	160,2 =55,01%	19,4 =32,7%	467,5 =42,8%

Angaben in 1000 Einwohnern
Data in Thousand Inhabitants

Tabelle IX. *Städte* / Table IX. *Towns*

Tripolitanien / Tripolitania

Tripolis-Stadt / Town

Einwohner / Inhabitants

1905:	(geschätzt)	30 000	(estimated)
1915:	(geschätzt)	50 000	(estimated)
1929:	(nach Daten)	65 688	(according to data)
1931:			
1936:			
1954:	(1. Census)	130 238	
1960:		183 473	
1964:	(2. Census)	212 577	

Wachstum / Development of population 1954/1964 um 63,52%
1964: 111 029 männliche Bewohner / male inhabitants
101 548 weibliche Bewohner / female inhabitants

Tabelle IX (Fortsetzung)/Table IX (Continued)

Städte / Towns (1964)

Zawia	28 349
Zuara	14 578
Homs	13 864
Misurata	36 850
Sirte	7 093
Jefren	20 058
Garian	10 807

Cyrenaica

Benghasi Stadt

1905:	(geschätzt)	25 000	(estimated)
1915:	(geschätzt)	30 000	(estimated)
1929:	(nach Daten)	31 248	(according to data)
1931:			
1936:			
1954:	(1. Census)	70 533	
1960:	fortgeschrieben	76 616	
1964:	(2. Census)	136 641	

Wachstum / Development of population 1954/1964 um 93,75%
1964: 38 855 männliche Bewohner / male inhabitants
31 678 weibliche Bewohner / female inhabitants

Städte / Towns (1964)

Adschedalia (Ajedabia):	15 430
Derna	21 432
Tobruk	15 867
Beida	12 799
el Merj (Barce)	3 387

Fezzan

Sebha (el Gedid)	1954:	7 193	
Sebha (el Gedid)	1964:	9 804	
Murzuk	1905:	10 000	(geschätzt)
Murzuk	1954:	2 832	
Murzuk	1964:	3 863	

Tabelle X. *Provinzen* / Table X. *Provinces*

Tripolitanien / Tripolitania

Einwohner / Inhabitants

1928:	(geschätzt nach Daten)	600 000	(estimated according to data)
1931:	(geschätzt nach Daten)	545 804	
1936:	(geschätzt nach Daten)	665 529	
1954:	(1. Census)	738 338	
1960:			
1964:	(2. Census)	1 029 216	

1964: 534 919 männliche Bewohner / male inhabitants
494 297 weibliche Bewohner / female inhabitants

Provinzen (Muquataa) / Provinces 1964

1. Tripolis Stadt und Land	376 177	Tripolis Town and Country
2. Dschebel Gharbi	181 334	
3. Zawia	189 032	
4. Homs	137 205	
5. Misurata	145 468	

Untergliederung der Provinzen 1964 / Subdivisions of the provinces in 1964

Mutessarifia = District (= Regierungsbezirk)

zu 1.	Tripolis-Stadt (19 Quarter)	212 577	Tripolis Town
	Suk el Dschuma	163 600	
zu 2.	Garian, Distrikt	61 366	
	Jefren, Distrikt	60 044	
	Misdah, Distrikt	18 177	
	Nalut, Distrikt	35 524	
	Ghadames, Distrikt	6 223	

Tabelle X (Fortsetzung)/Table X (Continued)

zu 3.	Zawia, Distrikt	110 466
	Sabratha, Distrikt	42 431
	Zuara, Distrikt	36 135
zu 4.	Homs, Distrikt	66 559
	Tarhuna, Distrikt	48 435
	Beni Ulid, Distrikt	22 211
zu 5.	Misurata, Distrikt	70 015
	Zliten, Distrikt	45 551
	Sirte, Distrikt	29 902

Cyrenaica

Einwohner / Inhabitants

1928:	(geschätzt nach Daten)	195 000	(estimated according to data)
1931:	(geschätzt nach Daten)	132 249	
1936:	(geschätzt nach Daten)	186 546	
1954:	(1. Census)	291 328	
1960:	fortgeschrieben	329 496	
1964:	(2. Census)	451 469	

1964: 235 526 männliche Bewohner / male inhabitants
215 943 weibliche Bewohner / female inhabitants

Provinzen (Muquataa) / Provinces 1964

(6) 1.	Benghasi Stadt und Land	279 565
(7) 2.	Dschebel Achdar	87 803
(8) 3.	Derna	84 001

Untergliederung der Provinzen 1964 / Subdivisions of the provinces in 1964

Mutessarifia = District (= Regierungsbezirk)

1.	Benghasi Stadt/Town (15 Quarter)	136 641
	Benghasi District	90 860
	Adschedabia (mit City) District	44 684
	Kufra District	7 482
2.	Beida Stadt/Town	12 799
	Beida District	35 141
	Marj (Barce) District	29 222
3.	Derna Stadt/Town	21 432
	Derna District	23 765
	Tobruk (mit Stadt/incl. Town) District	38 804

Fezzan

Einwohner / Inhabitants

1928:	(geschätzt)	110 000	estimated
1931:	(nach Daten)	28 212	according to data
1936:	(nach Daten)	36 581	according to data
1954:	(1. Census)	59 315	(incl. Gadames-District: 5151)
1960:			
1964:	(2. Census)	78 714	(ohne Gadames: 6223)

1964: 39 717 männliche Bewohner / male inhabitants
38 997 weibliche Bewohner / female inhabitants

Provinzen (Muquataa) / Provinces 1964

(9) 1.	Sebha	46 700
(10) 2.	Ubari	32 014

Untergliederung der Provinzen 1964 / Subdivisions of the provinces in 1964

Mutessarifia = District (= Regierungsbezirk)

zu 1.	Sebha	15 953
	es Schati	18 753
	el Dschofra	11 994
zu 2.	Ubari	9 866
	Oragen	2 632
	Murzuk	15 059
	Gat	4 457

Tabellen zur Gesundheitsstatistik / Tables of Health Statistic

Tabelle XI. *Gesundheitszentren für Mutter und Kind (1966)*

Table XI. *Maternal and Child Health Service (1966)*

	Schulen und Unterrichtszentren Health Schools and Demonstration Centres	Hauptzentren Main Centres	Unterzentren Subcentres	vorgesehen bis 1971 planned up to 1971
Tripolitanien				
1. Tripolis Stadt/Town	—	4	—	HZ 3 für Stadt/Town
Suk el Dschuma	1	—	—	1 (Prov.)
Tadschura	—	1	—	
Azizia	—	—	1	
2. Zawia	—	1	—	3 (Prov.)
Zanzur	—	—	1	
Sabratha	—	—	1	
Zuara	—	1	—	
3. Homs	—	—	1	3 (Prov.)
Tarhuna	—	—	1	
4. Misurata	—	1	—	2 (Prov.)
5. Dschebel Gharbi	—	—	—	4 (Prov.)
Garian	—	—	1	
Jefren	—	1	—	
Dschado	—	—	1	
Kabao	—	—	1	
Cyrenaica				
6. Benghasi	—	—	—	5 (Distr. u. Stadt)
Stadt	1	4	—	
Sidi Khalifa	—	—	1	
Adschedabia	—	1	—	1 (Distr.)
Kufra	—	—	1	
7. Dschebel Achdar	—	—	—	
Beida	—	1	—	
Susa	—	—	1	
Schahat	—	—	1	
el Marj	—	1	—	2 (Distr.)
8. Derna	—	—	—	1 (Distr.)
Stadt	—	2	—	
El Gubba	—	—	1	
Tobruk Stadt	—	1	—	1 (Distr.)
Fezzan				
9. Sebha (el Gedid)	—	1	—	2 (Prov.)
10. Ubari	—	—	—	2 (Prov.)

1.—10. = Provinzen/Provinces
HZ = Hauptzentrum/Main center
(Prov.) = in der Provinz = (Muhafed)
in the province = (Muhafed)
(Distr.) Distrikt = (Mutessarifiah)
District = (Mutessarifiah)

Tabelle XII. *Mollusken, die von Italienern in Libyen gefunden wurden*

Table XII. *Molluscs observed by Italian authors in Libya*

	Wahrscheinlich synonym mit der von der WHO anerkannten neuen Nomenklatur: Probably synonymous with the new nomenclature recognized by the WHO:
Bulinus contortus	Bulinus truncatus truncatus
Bulinus innesi	Bulinus truncatus truncatus
Physopsis africana (in der Cyrenaica)	Bulinus (physopsis) africanus (in the Cyrenaica)
Planorbis pfeifferi Planorbis ehrenbergi Planorbis metidjensis } Maharuga (Fezzan), Gat, Derna (Cyrenaica)	Biomphalaria pfeifferi Planorbarius metidjensis
Planorbis boissyi var. libyca (bei Tauorga) (durch RAGAZZI)	Biomphalaria alexandrina alexandrina (near Tauorga)
Planorbis numidius (Cyrenaica)	Planorbis numidius (Cyrenaica)
Melanoides tuberculata (Brak, Ubari, Gat und Umgebung)	
Limnaea laurenti (el Barkat bei Gat)	
Limnaea ovata (Brak und in der Cyrenaica)	Radix ovata (Brak and in the Cyrenaica)
nach GERMAIN: Bulinus strigosus var., westl. Form bei Gat	Biomphalaria pfeifferi rüppellii
außerdem nach RANSON: Planorbis rüppellii	Biomphalaria pfeifferi bridouxiana
as well according to RANSON: Planorbis bridouxianus	Biomphalaria pfeifferi gaudi
Planorbis gaudi	
Planorbis dalloni	
Limnaea exserta	

Tabelle XIII *siehe Seite 154* Table XIII *see page 154*

Tabelle XIV. *Die wichtigsten gemeldeten Krankheiten in Libyen von 1959—1963*

Table XIV. *The most important diseases reported in Libya 1959—1963*

List of diseases	Internat. Code	1959				1960				1961				1962				1963				Internat. Code	Deutsche Krankheitsbezeichnung
		Trip.	Cyr.	Fez.	Total Ges.	Trip.	Cyr.	Fez.	Total Ges.	Trip.	Cyr.	Fez.	Total Ges.	Trip.	Cyr.	Fez.	Total Ges.	Trip.	Cyr.	Fez.	Total Ges.		
Tuberculosis of Respir. System	01–08	1812	591	127	2530	1905	897	135	2937	2128	1042	163	3333	1826	1056	150	3032	1728	1043	93	2864	01–08	Tuberkulose der Atmungsorgane
Tuberculosis, other forms	10–19	31	128	34	193	78	60	40	178	226	69	121	416	295	93	13	401	420	61	26	507	10–19	Tuberkulose anderer Organe
Syphilis	20–29	224	34	26	284	178	39	10	227	149	27	2	178	62	27	2	91	42	15	·	57	20–29	Syphilis
GO and other Veneral Diseases	30–39	432	78	135	645	471	48	33	552	284	49	44	377	101	16	85	202	99	8	33	140	30–39	Gonorrhoe und sonstige Geschlechtskrankh.
Typhoid and Paratyphoid Fever	40–41	247	27	9	283	341	36	5	382	107	31	46	184	199	20	103	322	193	4	133	330	40–41	Typhus und Paratyphus
Other Salmonella Infections	42	·	·	·	·	·	5	21	26	·	·	33	33	·	·	6	6	·	·	·	·	42	Sonstige Infekte der Salmonellagruppe
Brucellosis	44	83	·	7	90	16	·	·	16	·	1	·	1	·	7	·	7	2	·	·	2	44	Brucellose
Bacillary Dysentery	45	34	54	152	240	117	49	26	192	486	60	42	588	503	117	11	631	149	3	33	205	45	Übertragbare Ruhr
Amoebiasis	46	108	67	109	284	80	186	70	336	387	209	214	810	159	131	510	800	106	208	650	964	46	Amoebenruhr
Unspecified Forms of Dysentery	47–48	·	13	262	275	·	10	616	626	·	·	692	692	1	·	372	373	·	1	168	169	47–48	Andere Formen der Ruhr
Food Poisoning	49	53	·	25	78	197	9	28	234	140	·	87	227	239	·	1	240	95	·	10	105	49	Bakt. Lebensmittelvergiftung
Scarlet Fever	50	·	·	·	·	15	·	1	16	45	1	4	50	86	·	·	86	61	·	·	61	50	Scharlach
Septicaemia and Pyaemia	53	·	·	12	12	·	·	5	5	65	·	1	66	·	·	·	·	·	·	1	1	53	Sepsis und Pyämie
Diphtheria	55	34	·	2	36	22	1	·	23	25	4	2	31	15	20	6	41	5	13	2	20	55	Diphtherie
Whooping Cough	56	3190	208	·	3398	1119	273	12	1404	1916	45	41	2002	3851	192	2073	6116	1045	161	549	1755	56	Keuchhusten
Meningococcal Infections	57	4	8	5	17	9	6	3	18	15	7	3	25	15	11	·	26	15	13	1	29	57	Meningokokken-Infektionen
Leprosy	60	17	12	·	29	12	10	1	23	13	1	·	14	15	2	·	17	20	5	·	25	60	Lepra
Tetanus	61	34	21	·	55	46	23	·	79	39	16	·	55	48	23	·	71	38	24	·	62	61	Tetanus
Anthrax	62	12	17	·	29	10	218	·	228	3	144	·	147	29	20	·	49	10	13	·	23	62	Milzbrand
Gas Gangrene	63	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	4	·	4	63	Gasgangrän
Other Bact. Diseases	64	·	·	·	·	·	·	25	25	·	·	38	38	·	·	·	·	·	·	30	30	64	Sonstige bakt. Krankh.
Vincent Infection	70	·	27	21	48	·	253	8	261	·	·	104	104	·	·	6	6	·	·	·	·	70	Spirochätenkrankh.
Relapsing Fever	71	·	·	2	2	·	3	·	3	·	·	·	·	15	·	·	15	·	·	·	·	71	Rückfallfieber
Acute Poliomyelitis	80	61	17	·	78	20	26	·	46	49	28	2	79	59	1	·	60	147	17	3	167	80	Übertragbare Kinderlähmung

Tabelle XIV (Fortsetzung)/Table XIV (Continued)

List of diseases	Internat. Code	1959 Trip.	1959 Cyr.	1959 Fez.	1959 Total Ges.	1960 Trip.	1960 Cyr.	1960 Fez.	1960 Total Ges.	1961 Trip.	1961 Cyr.	1961 Fez.	1961 Total Ges.	1962 Trip.	1962 Cyr.	1962 Fez.	1962 Total Ges.	1963 Trip.	1963 Cyr.	1963 Fez.	1963 Total Ges.	Internat. Code	Deutsche Krankheitsbezeichnung
Acute Infectious Encephalitis	82	·	·	·	·	·	·	·	·	16	·	·	16	10	2	·	12	4	·	·	4	82	Akute übertragbare Gehirnentzündung
Measels	85	2764	735	18	3517	3671	537	83	4291	7457	1160	725	9342	3713	695	298	4706	1675	1831	140	3646	85	Masern
Rubella (Germ. Measles)	86	·	·	15	15	·	·	11	11	·	4	7	11	·	12	·	12	·	38	50	88	86	Röteln
Cickenpox	87	672	129	52	853	626	122	54	802	400	75	75	550	656	24	116	796	811	24	416	1251	87	Windpocken
Herpes Zoster	88	·	·	4	4	·	·	·	10	·	·	9	9	·	11	18	29	42	19	10	71	88	Herpes Zoster
Mumps	89	1984	268	62	2314	288	111	58	457	226	24	30	280	1655	19	16	1690	981	117	84	1182	89	Mumps
Dengue	90	·	·	·	·	·	·	·	·	·	·	16	16	·	·	·	·	·	4	·	4	90	Denguefieber
Infectious Hepatitis	92	·	7	45	52	·	45	63	108	·	5	68	73	·	·	76	76	·	2	73	75	92	Übertragb. Hepatitis
Infect. Mononucleosis	93	·	5	·	5	·	·	·	·	·	·	5	5	·	·	1	1	·	·	33	33	93	Pfeiffersches Drüsenfieber
Rabies	94	16	·	·	16	9	·	·	9	6	6	·	12	11	·	·	11	·	·	·	·	94	Tollwut
Trachoma	95	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	4126	·	·	4126	95	Trachom
Other Virus Diseases	96	·	·	·	·	·	·	2	2	·	·	·	·	·	·	·	·	·	·	18	18	96	Sonst. Viruskrankh.
Louse-borne Epidemic Typhus	100	21	15	·	36	11	40	·	51	6	1	·	7	3	·	·	3	·	2	·	2	100	Läuse-Fleckfieber
Malaria	110 ff.	1	66	149	216	·	7	16	23	·	17	15	32	1	19	12	32	·	5	12	17	110	Malaria ff.
Leishmaniasis	120	1	·	1	2	·	·	1	1	·	·	·	·	·	5	·	5	·	·	·	·	120	Leishmaniose
Other Protozoal Diseases	122	·	·	·	·	·	·	·	·	·	106	5	111	·	·	36	36	·	·	2	2	122	Sonstige Protozoenkrankheiten
Schistosomiasis	123	1	6	162	169	5	2	273	280	25	14	333	372	27	10	460	497	4	13	328	345	123	Bilharziose
Other Trematode Infestation	124	·	·	3	3	·	·	30	30	·	·	·	·	·	·	·	·	·	·	32	32	124	Sonstige Wurmkrankheiten
Ankylostomiasis	129	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1	1	129	Hakenwurmkrankheit
Infestation with other Worms	130	·	7	196	203	372	·	·	372	·	·	547	547	·	·	487	487	·	·	134	134	130	Sonstige Wurmkrankheiten
Dermatophytosis	131	·	256	108	364	·	641	37	678	3	640	30	673	5813	892	218	6923	·	606	80	686	131	Dermatophytose
Actinomycosis	132	·	15	4	19	2	·	·	2	·	·	5	5	·	·	·	·	·	·	·	·	132	Aktinomycose
Other Fungus Infections	134	·	·	55	55	18	·	·	18	·	·	4	4	·	·	83	83	·	·	21	21	134	Sonst. Pilzinfektionen
Scabies	135	·	·	5	5	·	7	·	7	·	9	4	13	·	1	·	1	·	·	·	·	135	Krätze
Other Infections and Paras. Diseases	138	·	·	·	·	·	·	·	·	·	·	16	16	·	·	2	2	·	·	168	168	138	Sonstige infektiöse und parasitäre Krankh.
Influenza	180–183	·	·	·	·	·	·	·	·	1475	341	827	2643	2872	761	1290	4923	913	287	784	1984	180–183	Grippe
Enteritis	571	·	·	·	·	·	·	·	·	5206	49	1457	6712	5381	·	1144	6525	4235	130	1044	5409	571	Darmentzündung
Puerperal Fever	681	·	·	·	·	·	·	·	·	61	1	25	87	129	1	14	144	175	·	11	186	681	Kindbettfieber

Tabelle XIII. *Bilharziose im Fezzan* / Table XIII. *Bilharziasis in Fezzan*

Buanis:

	Infizierte/ Infected persons *		Bulinus	
El Gedid	41%	(71%)	+++	(+)
Gara Sebha	0	(0)	0	(0)
el Gorda	27%	(62%)	+	(0)
es Zighen	27%	(0)	+	(0)
Semnu	14%	(0)	+	(0)
Temenhint	10%	(50%)	+	(0)
Goddua	—	(99%)	—	(+++)

Wadi Adschal:

	Bulinus
Hatiya Disa (4 km ö Ubari)	+
Dscherma	
Brech	
Tekertiba	
Bendbeya	
Klef	
el Abid	

Hofra:

Murzuk	—	(41%)	+	
el Ain (Fongul)	37%		++	
Traghen	47%	(92%)	+++	
Hammera	90%		++	
Zuila	0	(0)	0	
Tmessa	44%		+	

Wadi es Schati:

Brak	0	(62%)	++	(+++)
Agar	12%	(8%)	0	
Maharuga	55%	(97%)	+++	(+++)
el Gorda	15%	(33%)	0	
Berguin	0	(0)	0	
Edri	0	(0)	0	

Wadi Hekma:

	Infizierte/ Infected persons *		Bulinus
Gatrun	0		0
el Backi	47%		++
südl. Dörfer	0	(3%)	++

Zeichenerklärung:

+, ++, +++ } Verschiedene Stärken des Auftretens
0 nicht nachgewiesen
— nicht untersucht
* . . . . . Befall der Bevölkerung in Prozent *
% . . . . . nach Vermeil, Frühjahr 1951
in Klammern nach Natasi, Sommer 1937

Legend:

+, ++, +++ } different intensity of incidence
0 . . . . . not proved
— . . . . . not examined
% . . . . . in per cent. of population *
* . . . . . according to Vermeil, spring 1951
in brackets according to Natasi, summer 1937

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Arch. = Archivio italiano di scienze mediche coloniale; seit 1953: Archivio italiano di scienze mediche tropicali e di parassitologia
Boll. = Bolletino Sanitario della Tripolitania

Das Schrifttum ist für jeden Teil des Buches nach Verfassernamen alphabetisch angeordnet.

Here only the most important literature is given. The most mentioned periodicals are abbreviated as follows:

Ann. = Annales della societa medica coloniale della Libia
Arch. = Archivio italiano di science mediche coloniale; since 1953: Archivio italiano di scienze mediche tropicali e di parassitologia
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Siebeck, R.: Trachom I, II, III.
Bormann, F. v.: Fleckfieber I, III.
Piekarski, G., u. A. Westphal: Amoebenruhr I.
Piekarski, G., *et al.:* Leishmaniasen I, II, III.
Raettig, H., H. Felten u. R. Langer: Pest II.
Littann, K.: Lepra II.
Henneberg, G.: Pocken II.
Ulmann, E.: Dengue II, III.
Terhaag, L.: Q-Fieber II.
Schlieper, C.: Ascariasis II.
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Index geographischer Namen · Geographical Index

Geographische Namen, die im Text erwähnt sind:	Lage im Planquadrat auf der Karte 17
Geographical names mentioned in the text:	Situation on the map square in Map 17

Andere Schreibweisen oder ein zweiter Name für den gleichen Ort sind in eckige Klammern gesetzt.

Buchstaben und Zahlen in Klammern weisen auf Orte hin, die nicht in der Karte eingetragen sind, Ortsangaben in Klammern auf ihre Lage im Planquadrat.

Other manners of writing or a second name for the same place are put in square brackets.

Letters and figures in brackets point to places not registered in the map, places in brackets to the situation on the map square.

W: = westlich von / West of S: = südlich von / South of
E: = östlich von / East of N: = nördlich von / North of

Abiad, el (W: Adschal)	(D 4)
Abiar, el	G 1
Adem, el (airport)	H 2
Adjal Wadi	(C 4)
Adschedabia	G 2
Ägypten	I 1—7
Agar (Brak)	(D 4)
Agelat [Agalat] (Sabrata)	(C 1)
Agheila, el	F 2
Ain Debussia (W: Derna)	(H 1)
— el Bilad (Wadi Derna)	(H 1)
— el Fras (Gadames)	(A 2)
— el Hammam (Socna)	(D 3)
— Mansur (Wadi Derna)	(H 1)
— Gazzala (E: Tmimi)	(H 1)
— Mara (S: Derna)	(H 1)
— Schahat (Cyrene)	(G 1)
— Tobi (Garian)	(C 1)
— Turk (Garian)	(C 1)
— Zara	(C 1)
— Zeiana (Benghasi)	(G 1)
— [Ein] Zueia	I 7
Ajedabya [Ajidabia]	G 2
Akakus (Gat)	(B 5)
Alalga	(C 1)
Algeria, Algerien	AB 2—6
Amsach Mellet (SW: Ubari)	(C 4)
Amsach Settafed (W: Ubari)	(B 4)
Amseat (Sollum)	(I 2)
Angud el Jaserat (S: Harudsch)	(E 4)
Apollonia [Marsa Susa]	G 1
Arkenu Inselberg	I 6
Arreskia See [Areskia Lake] (Dscharabub)	(I 3)
Assenu well	G 6
Audschila [Augila]	G 3
Auenat Inselberg	I 7
Auenat [=Serdeles]	B 5
Aujila	G 3
Azizia	(C 1)
Bab el Gedid (Tripolis Stadtteil)	(C 1)
Bab el Maknusa (Wadi Adschal)	(C 4)
Bacchi (Gatrun)	(D 5)
Bahar ed Dud	(C 4)
Bahar et Truna	(C 4)
Baracca [Fasura] (Barce)	(G 1)
Barce [el Merj]	G 1
Bardia, el	I 2
Barga el Beda	(G 1—2)
Barga el Hamra	(G 2)
Barka [Barce]	G 1
Batus (S: Azizia)	(C 1)
Beda [Beida]	G 1
Bei el Kabir Wadi	(C 2—3)
Ben Gaschir [Gascir]	C 1
Ben Gashir	C 1
Benghasi [Benghazi]	G 1
Benina	G 1
Beni Ulid	C 2
Beni Ulid Wadi	(CD 2)
Berdjudj Wadi	(BC 5)
Berenice [Euhesperide, Benghasi]	(G 1)
Bergin (Wadi es Schati)	(C 4)
Berka, el (Benghasi)	(G 1)
Bettafel, well [Buttafal] (Jalo)	(G 3)
Bianchi [=Azzahra] (Zavia)	(C 1)
Bilad spring (Derna)	(H 1)
Bir Assenu	G 6
— Bettafal (Dschalo)	G 3
— Bischara [Maaten B.]	H 6
— Dacar (N: Rand des Kufraberglandes)	(H 5)
— el Ghnem	C 1
— Regil (NW: Socna)	(D 3)
— Rezzen	(G 2)
— Sarra [Sarratafel]	G 7
— Um el Adam (Wadi Hecma)	(D 5)
— Waar (Tümmo)	D 6
— Waschka [Washka] [Uesca] (Dschebel es Soda)	D 3
Bomba (Cyrenaica)	(H 1)
Brak	D 4
Buanis (Sebha)	(D 4)
Bu el Geddahia	D 2
Buema (el Dschof)	(H 5)
Buema See (E: el Dschof)	(H 5)
Buerat (es Hsun)	D 2
Bu Gheilan (N: Garian)	(C 1)
Bu Heira (Sebka)	(D 5)
Bu Meliana (Tripolis Stadtteil)	(C 1)
Bu Ngem	D 2
Bu Salama (Bir, Well) (W: Dscharabub)	(I 3)
Busetta (Tripolis Stadtteil)	(C 1)
Bzema (Oase)	H 5

Cabao (B 2)
Caf (el) Wadi (G 1)
Calansho Serir, Erg G 4
Cape Misurata D 1
Capuzzo [Musaid] I 2
Castel Verde (Tripolis) (C 1)
Chad EF 7
Cidamus [Gadames] A 2
Cillaba [Zuila] D 4
Coefia (G 1)
Cussabat [Cusbat, Gusbat, Kussabat] D 1
Cyrenaica GH 2
Cyrene [Schahat] (G 1)

Dahar (Tarhuna) (C 1)
Dahra — Ölfeld E 3
Daphnia (römische) (roman) (D 1)
Derna H 1
Derna Wadi H 1
Debussiaquelle (=spring, well) (H 1)
Dersch [Derg] B 2
Dohone [Dohozano] F 6
Dor Abregh [Abragh] F 4
— el Gani (E 4)
— el Gussa (E 5)
— el Msid (E 4)
Dschado [Jado] C 2
Dschalo [Jalo] (el Ergh) G 3
Dschanet [Djanet] A 5
Dscharabub I 3
Dschebel (tripolitanische) BC 2—1
Dschebel Achdar GH 1
— Arkenu I 6
— Ati (N: Tümmo) (D 6)
— Auenat I 7
— Babein (N: Arkenu) (I 6)
— Ben Ghnema D 5
— Clinge (Dsch. Egei) (G 6)
— Egei G 6
— es Soda DE 3
— Fezzan D 3
— Gargaf C 4
— Gussa E 5
— Hedschar (Serir Tibesti) (E 6)
— Kissu [s. Auenat] (I 7)
— Nefusa C 1—2
— Tarhuna (C 1)
— Waddan (E 3)
— War [Waar], (Tümmo) D 6
— Zelten F 3
Dschedid [Gedid], -Sebha D 4
Dschefara BC 1
Dscherma [Garama, Jerma] C 4
Dschkerra [Jakhira, Jikerra] G 3
Dschof, el [El Giof] H 5
Dschofra (Hon) (DE 3)
Dschosch [Giosh]=[Dshonosh] B 1

Edeien von Murzuk C 5
Edeien von Ubari B 4
Edeyin of Murzuk C 5
Edeyin Ubari B 4
Edri C 4
Egei Tafel G 6
Egei Wadi (G 6)
Egypt I 1—7
Ein [Ain] Zueia I 7
Elbarcat (Gat) (B 5)
El Erg G 3
Endjarren Wadi (N: Tesaua) (C 4)
Erdi (Landschaft SE-Libyen) (H 8)
Erg Dscharabub I 3
Ergh, el [Dschalo, Jalo] G 3
Erg Jarabub [Jaghbub] I 3
Erg Kalanscho [Calansho] (F 4)
Erg Rebiana G 5
Erg Titagsin (SW: Serdeles) (B 5)
Etba Niederung (Tesaua) (C 4)
Etba Flats (C 4)
Etscheleh [Edjeleh] (Ölfeld) A 4
Euhesperide [Berenice], [Benghasi] G 1
Ezzelet (W: Tmimi) (H 1)

Faregh Wadi (Calansho Serir) (G 4)
Farga See (Dschado, Jado) (C 2)
Farigh Wadi (Cyrenaica) (F—H 2)
Fassa See (Dscharabub) I 3
Fasura [Baracca] (Barce) (G 1)
Fazura [Barce] (G 1)
Feuat (Gat) (B 5)
Fezzan CD 4—5
Fgeg (Wadi Adschal) (C 4)
Fogha, el [Fogaha] E 4
Fonduk Nagazza (Homs) (D 1)
Fugha E 4

Gadames [Ghadames], [Cidamus] A 2
Gaf el Garbi (S: Dschebel es Soda) D 3
Gagra (Wadi Adschal) (C 4)
Gamil, el [Gemil] (bei/near Zuara) (C 1)
Garabulli (E: Tripolis) (C 1)
Garama [Dscherma] (Wadi Adschal) C 4
Gardens of the Hesperides (Benghazi) (G 1)
Garet es Sebaa (1200 m) (E 4)
Gargaf (Gargaf Jebel) C 4
Gargaresch (Tripolis) (C 3)
Garian C 1
Gariunes (Benghasi) (G 1)
Gat [Ghat] B 5
Gatrun D 5
Gattara Wadi (S: Benghasi) (G 2)
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Gerdes el Abid (S: Barce) (G 1)
Gerdes Gerari (Benghasi) (G 2)
Geriat el Garbia (bei G. es Schergia) (C 2)
Geriat es Schergia [Gheriat] C 2
Gesiret Geliana (Benghasi) (G 1)
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Ghemines G 2
Gheneien Sebka (Cyrenaica) G 2
Gheriat el Garbia (C 2)
Ghirza (NE: Geriat) (D 2)
Ghirza Wadi (zum Wadi Zemzem) (D 2)
Gibla (S: des Dschebels) (B—D 2)
Gilf Kebir (Ägypten) (I 5)
Giorgimpopuli (Tripolis) (C 1)
Gira (E: Brak) (D 4)
Gleb Wergan (Dsch. es Soda) (D 3)
Goddua (N: Murzuk) D 4

Golf von Bomba H 1
Gorda, el (Sebha) (D 4)
Great Sirte bay F 2
Grefa, el (Wadi Adschal) C 4
Grei Mado (Vulkan/Volcano) (F 6)
Große Syrte (Golf) EF 2
Gsebaia See (Dscharabub, Jaghbub) (I 3)
Guarscha (Benghasi) (G 1)
Gubba H 1
Gubo Massiv [Massif Tibesti] (F 6)
Gulf of Bomba H 1
Gusbat [Kussabat] D 1

Hadjara [Hadschara] (Sebha) (D 4)
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Haleigh (W: Harudsch) (E 4)
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Hofra, Ölfeld (EF 3)
— el Garbia (E: Murzuk) (CD 4—5)
— es Schergia [Schargia] (D 4)
Homs D 1
Hon D 3
Hongraben D 2—3

Idinen (Gat) (B 5)
Idris, Flugplatz (airport Tripolis) C 1
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Irauen Wadi (W: Ubari) (BC 4)
Izeien Wadi (Gat) (B 5)

Jado I 2
Jaghbub I 3
Jalo (el Ergh) G 3
Janet (Fort) A 5
Jauf, el [Jof, El Giof] H 5
Jebel Akhdar [Achdar] GH 1
— Arkenu I 7
— Ati [N: Tummo] (D 6)
— Auenat I 7
— Babein [N: Arkenu] (I 6)
— Ben Ghnema D 5
— Clinge (J. Egei) (G 6)
— Egei G 6
— Escarpment (Tripolitanien) (B 2—C 1)
— Gussa E 5
Jebel Kissu (S: Auenat) (I 7)
— Sauda DE 3
— Tarhuna (C 1)
— Uweinat (Auenat) I 7
— Waddan (E 3)
— War (D 6)
Jefara BC 1
Jefren C 1
Jerma [Garama] C 4
Jikerra [Jakhira] G 3
Jofra [Hon] = Trough (D 2—3)

Kalanscho-Serir G 4
Kararim [Gioda] (S: Misurata) (D 1)
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Kemet-Massiv (Tibesti N) [Massif de Kemet] F 6
Kersa (W: Derna) (H 1)
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Kikla Trough (C 1)
Kneir Wadi (N: Sebha) (D 4)
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Kussabat [Gusbat, Cussabat] D 1

Lake Buema (el Jauf) (H 5)
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— Lagoon (B 1)
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Madschedul (Plateau) (D 5)
Mager Wadi (Zliten) (D 1)
Maharuga (Brak) (D 4)
Maia, el (Zavia) (D 1)
Mandara (N: Wadi Adschal) (C 4)
Mangeni Plateau C 6
Mara (Dschebel Achdar) (H 1)
Marada F 3
Marble Arch F 2
Marina Misurata D 1
Marmarika [Marmarica] HI 1—2
Marsa el Brega [Marsa Bregha] F 2
— Luch (Sollum) (I 2)
— Susa [Apollonia] G 1
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Megenin Wadi (Garian) (C 1—2)
Mehemesa (Hattia) (N: Kufra Bergland) (H 5)
Meherschema (S: Wau el Kebir) (E 6)
Melfa (Dscharabub) (I 3)
Mellaha (Tripolis) (C 1)
Menscha (Menscia) bei/near Zuara (C 1)
Menschar-Hügel (Dschebel Tripol. Rand) (C 1)
Mensha (Zuara) (C 1)

Menshar Hills (C 1)
Merj, el [Barce] G 1
Mesach Mellet (E: von Gat) (B 5)
Mesak Settafed (Ubari) (B 4—5)
Messa [Massa] (Cyrenaica) G 1
Mgarin (Rommel-) See (Benghasi) (G 1)
Mimun Wadi (Beni Ulid) (CD 2)
Misda [Mizda] C 2
Misurata (Stadt, Kap, Marina) D 1
Mohammera (Haschan) (Zavia) (C 1)
Mra (el) Wadi (N: Jaghbub) (H 2)
Mscheggheg (Harudsch) (E 4)
Msellata (C 1)
Mshegghegg (E 4)
Mugtaa el Chebrit (W: Agheila) (F 2)
Mugtaa Sebkh (F 2)
Musaid [M'Said, Capuzzo] I 2
Mzezzem (Gadames) (A 2)

Nab el Geru (N: Brak) (D 3)
Nalut B 2
Neshaua Wadi (Tesaua) (CD 4)
Niger BCD 7

Oberdan (E: Barce) (G 1)
Oea [Tripolis] (C 1)
Oragen (SW: Ubari, District) (C 4—5)

Pik (Pic) Bette (2285 m) (Tibesti) F 6
Psiara (Gubba, Dschebel Achdar) (H 1)
Ptolemais [Tolmeta] G 1

Ramla el Kebira (E: Gargaf) (D 4)
— Marzukia (S: Hofra es Schergia) (D 4)
Ramlet Buanis (Sebha) (C 4)
— Zellaf (E: Edeien Ubari) (C 4)
Ras Hilal H 1
— Lanuf F 2
Rawawus Wadi (E: Hamada el Hamra) (D 2—3)
Rebiana (Oase) G 5
Rebiana sand sea, Erg G 5
Regdalin (S: Zuara) (B 1)
Regima, er (SE: Benghasi) G 2
Rumia Gorge Schlucht (Jefren) (C 1)

Sabrata [Sabratha] (C 1)
Sahabi G 2
Sarra-Tafel (Plateau) GH 6—7
Schahat [Cyrene] G 1
Schekschuk [Scecsciuch] (N: tripol. Dschebel) (B 1)
Scheleidima (E: Soluk) (G 2)
Schueref, es D 2
Sebha D 4
Sebka di Punta (Benghasi) (G 1)
— el Gheneien G 2
— el Mrer (NE: Marada) FG 2
— Gheizel F 3
— Mugtaa el Chebrit F 2
— Selmani (Benghasi) (G 1)
— Tauorga D 1—2
— von (of) Meheiriga G 3
Serdeles (Auenat) B 5
Serir Dscharabub HI 4
— el Gattusa (D 4)
— Kalanscho [Calansho] G 3
Serir Tibesti EF 5—6
— Um Alla CD 4
Shati Wadi (es) CD 4
Shekshuk (N: tripolitan. Dschebel) (B 1)
Sheleidima (E: Soluk) (G 2)
Sidi Mesri (Tripolis) (C 1)
— Sultan (N: Adjedabia) (G 2)
Sidr (es) F 2
Sinauen B 2
Sirte E 2
Sirteland [Sirte desert] EF 3
Siwa I 3
Slonta (G 1)
Socna D 3
Sollum I 2
Soluk G 2
Sorman (Sabrata) (C 1)
Suani ben Adem (N: Azizia) C 1
Sudan I 8
Sugh el Chmis (E: Homs) (D 1)
Suk el Dschuma (Tripolis) (C 1)
— el Juma [Giuma] (Tripolis) (C 1)
Syrte (Landschaft) E 2

Tadrat (Plateau) (B 5)
Tadschura (E: Tripolis) (C 1)
Tag, et (Kufra, el Dschof) (G 5)
Taita (Dünen Wüste) (S: Serdeles) (dune desert) (B 5)
Tajura (E: Tripolis) (C 1)
Tamina [Crispi] (S: Misurata) (D 1)
Tanezzuft Wadi (N: Gat) (B 4—5)
Tarat Wadi (Gat) (B 5)
Tareglat-Caam Wadi (W: Zliten) CD 1
Tarhuna Jebel C 1
Tarhuna Stadt C 1
Taskemamal Wadi (N-Tibesti) (F 6)
Tassili (A 5)
Tauorga [Taworgha] D 1
Tazerbo G 5
Tedscherri (Wadi Hecma) D 5
Tegerhi D 5
Tegrinna (Garian) (C 1)
Tekro (G 8)
Tekut [- Vulkan, volcano] (Garian) (C 1)
Tesaua C 4
Teuchira [Tokra] G 1
Tgutta (Derg) B 2
Tibesti Massif (E 7, F 7, 8)
Tibesti Serir EF 6
Tigi [Tischi] B 1
Tishi B 1
Tmed Aleua (N: Wau en Namus) (E 5)
Tmessa (Hofra es Schergia) D 4
Tmimi H 1
Tneneca (E: Dohone) (G 6)
Tobga (Geriat) (C 2)
Tobruk I 1
Tokra (Tocra) G 1
Tolmeta [Ptolemaide, Tolmeitha] G 1
Traghen D 4
Tripolis [Tripoli] C 1
Tripolitanien [Tripolitania] B—E 1—2
Tripolitanischer Dschebel (BC 2)
Tripolitan Jebel [Tripolitanian Jebel] (BC 2)
Trona (C 4)

Trough of Hon (DE 2—3)
Tschad EF 7
Tuebia (W: Tripolis) (C 1)
Tümmoberge (Tummo mountains) D 6
Tuil Said (Vulkan-volcano) (S: Garian) (C 2)
Tunesien (Tunisia) A 1—4
Tusside, Pic (Tibesti) F 6
Tuzugu (N: Tibesti) (F 6)

Ubari C 4
Uigh es Seghir (SE: Tedscherri) (D 5)
Um el Araneb (Hofra el Garbia) D 4
Um er Rezzem Wadi (SE: Derna) (H 1)
Uotia [Wotia] (Brunnen) B 1
Uri (Tibesti) (F 7)

Waddan E 3
Wadi Adschal (Fezzan) (C 4)
— Agheib (N: el Fogha) (E 3)
— Bei (Bey) el Kebir (C 2—3)
— Beni Ulid (D 2)
— Berdschudsch [Berjush, Berdjudj] (W: Tesaua) (BC 5)
— Caam [Tareglat] (D 1)
— Derna (H 1)
— Debussia (W: Derna) (H 1)
— el Caf (Dschebel Achdar) (G 1)
— el Faregh (Syrte) (FG 2)
— el Kebir el Garegh (C 6)
— el Mra (N: Dscharabub) (H 2)
— Endjarren (N: Tesaua) (C 4)
— es Schati (Fezzan) (CD 4)
— Etba (W: Murzuk) (C 4)
— Farigh (Serir Kalanscho) (G 4)
— Gan (Ghan) (Garian) (C 1)
— Gattara (Benghasi) (G 2)
— Ghirza (zum W. Zemzem) (CD 2)
— Hamin (E: Syrte) (G 2)
— Hamuda (Brak, Gira) (D 4)
— Hekma, Hecma (Gatrun) (D 5)
— Hira (Garian) (C 1)
— Homs (D 1)
— Huelfa (E: Garian) (C 1)
— Irauen (W: Ubari) (BC 4)
— Izeien (Gat) (B 5)
Wadi Jamal (Garian) (C 1)
— Kneir (N: Sebha) (D 4)
— Lebda (Homs) (D 1)
— Lete (Benghasi) (G 1)
— Mager (Zliten) (D 1)
— Maid (Garabulli) (C 1)
— Megenin (Garian) (C 1—2)
— Mimun (Beni Ulid) (D 2)
— Neschaua (E: Tesaua) (CD 4)
— Ramla (W: Garabulli) (C 1)
— Rawawus (zum Bei el Kebir) (D 2—3)
— Schegua (E: Murzuk) (D 5)
— Soffedschin (CD 2)
— Soffedshin (Soffedjin) (CD 2)
— Tanezzuft (N: Gat) (B 5—4)
— Tarat (W: Serdeles) (B 5)
— Tareglat-Caam (Homs) (D 1)
— Targut (E: Garabulli) (C 1)
— Taskemamal (Tibesti) (F 6)
— Tenarut (Dersch) (AB 2)
— Tfelgu (Misda) (C 2)
— Um er Rezzem (S: Derna) (H 1)
— Zellaf (S: Brak) (CD 4)
— Zemzem (E: Hamada el Hamra) (CD 2)
— Zettar (Geriat es Schergia) (C 2)
— Zigza (Brak) (D 4)
Wau el Kebir E 5
— en Namus E 5
Wenzerik (Wadi es Schati) (C 4)
Wheelusfield (E: Tripolis) C 1

Zanzur (Zavia) (C 1)
Zavia (es) [Zawia] C 1
Zegher (Kalktafel = limestone table) (B 4)
Zeiana well (Benghasi) (G 1)
Zella E 3
Zellaf Wadi (S: Brak) (CD 4)
Zelten, Tafelberg (SE: Marada) FG 3
Zemzem Wadi (E: Hamada el Hamra) (CD 2)
Zighen-Oasen-Group (N: Kufra) H 5
Zigza Wadi (Brak) (D 4)
Zintan (tripolitan. Dschebel) (C 2)
Zliten (Oase) D 1
Zuara C 1
Zuetina [Zueitina] G 2
Zuila D 4

Bildbeilagen

Illustrations

Text of the figures translated by Christiane Prahst, Heidelberg



Abb. 1. Tripolis, Altstadt. Blick vom Kastell gegen SW auf den Uhrturm (gebaut 1870), dahinter den Basar, r. Straße mit Holzbalken zum Abdecken mit Matten im Sommer. Die Straße mit Läden im Vordergrund „Re Saud" führt nach r. zum Hafen. Das Hotel Victoria vorn ganz rechts ist jetzt (1964) abgerissen. (1962)

Fig. 1. Tripoli, old part of the town. View from the Castel towards the clock-tower (built in 1870) in the South-West, behind it the bazaar. On the right: street with wooden beams to be covered with mats in summer. The street with shops in the foreground, "Re Saud", leads to the harbour. The Victoria Hotel, on the right, has been pulled down (1964). (1962)



Abb. 2. Die Dschefara südl. von Azizia. Trockenfeldbau der Araber (Hakenpflug). (1957)

Fig. 2. The Jefara south of Azizia. Dry farming of the Arabs (hoeing-plough). (1957)



Abb. 3. Tripolitanischer Dschebel, obere Rumiaschlucht und -oase südl. von Jefren. Quellen in der Schlucht, Terrassenfeldbau. (1962)

Fig. 3. Tripolitanian Jebel, upper gorge and oasis of Rumia south of Jefren. Springs in the gorge, terrace-cultivation. (1962)



Abb. 4. Sebka von Tauorga, Salztonboden mit auskristallisiertem Salz bedeckt, Salzpflanzen. Hütten der Eingeborenen aus getrockneten Lehmziegeln, Dach aus Palmwedeln. (1962)

Fig. 4. Sebkha of Taworgha, halomorphic soil covered with crystallized salt, saline plants. The cottages of the natives are made of loam tiles, the roof is made of palm branches. (1962)

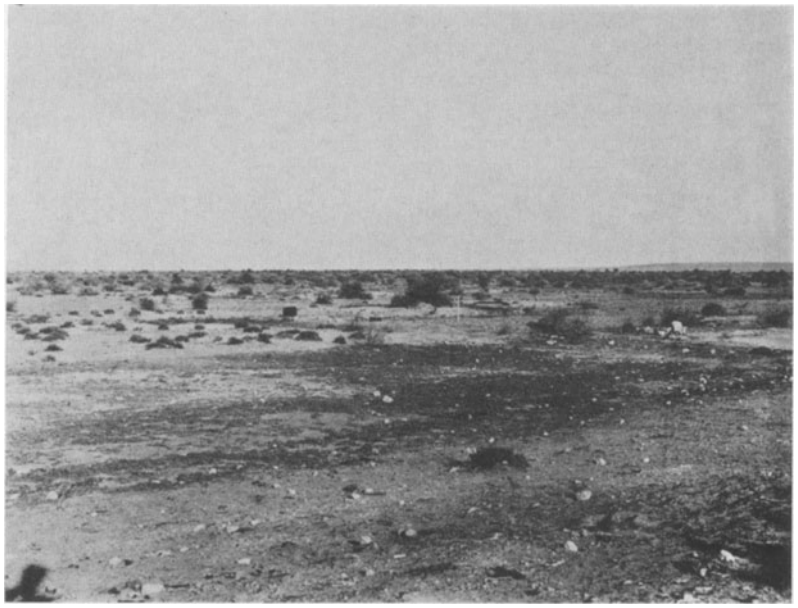


Abb. 5. Dichte Busch-Zwergstrauchsteppe am Bir Gelania, Wadi Zemzen, im Vordergrund grüne Krautsteppe. (1937)

Fig. 5. Steppe, densly covered with low bushes, near Bir Gelania, Wadi Zemzem, green herb-steppe in the foreground. (1937)

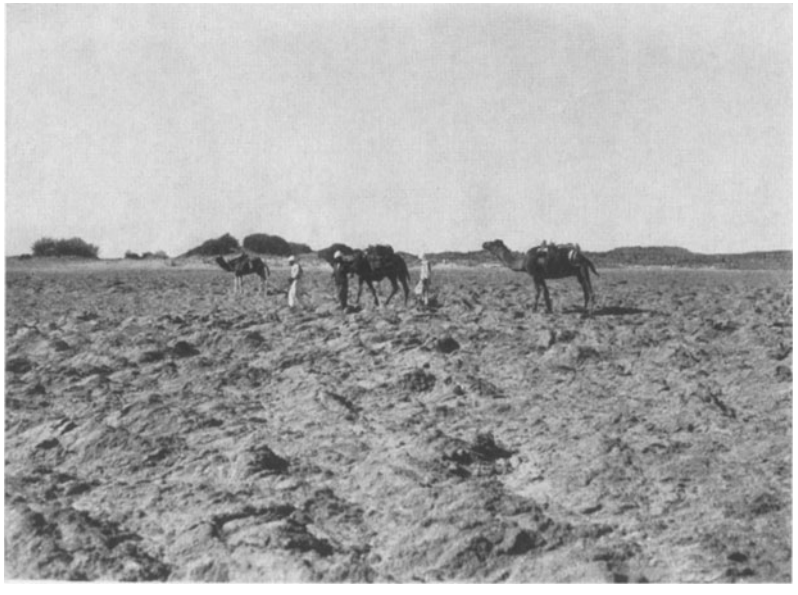


Abb. 6. Wadi es Schati bei Edri, Sebka. Die Salztonflächen sind in Schollen zerbrochen. Im Hintergrunde li. Kupsten mit Palmgestrüpp. (1933)

Fig. 6. Wadi es Shati near Edri, Sebkha. The salt-soil surface has broken into clods. In the background, left, the remainder of blown-off sand dunes, called Kupsten, with palm thicket. (1933)



Abb. 7. Wadi es Schati, weithin versalzter Boden neben kleinem Wadi infolge Erschließung zu viel artesischen Wassers nördl. von Maharuga. R. Oase Agar, dahinter liegt Brak. (1962)

Fig. 7. Wadi es Shati, mostly saline soil beside small Wadi as a cause of the development of too much artesian water north of Maharuga. On the right: oasis of Agar, behind it, Brak. (1962)

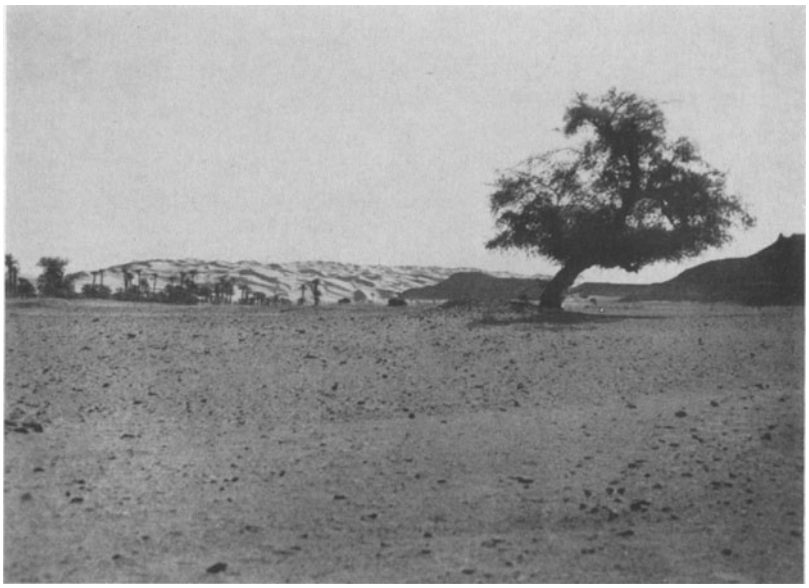


Abb. 8. Wadi Adschal bei el Fgeg. Blick von S über Wadital. R. der Sandsteinsporn bei Larocu, hinter der Oase die erste große Düne der Edeien von Ubari. Alte Akazie. (1942)

Fig. 8. Wadi Adjal near el Fgeg. View from the South over the Wadi valley. On the right: The sandstone spur near Larocu; behind the oasis: the first big dune of the Ubari sand sea (Edeyin). Old acacia tree. (1942)

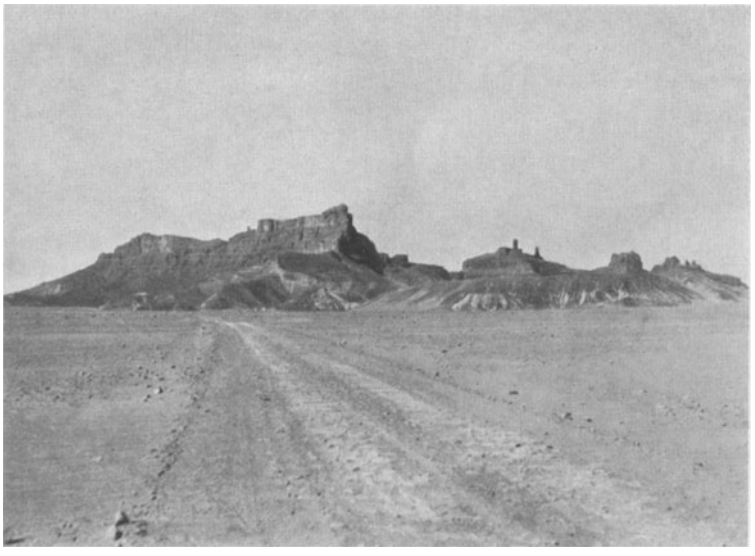


Abb. 9. Der Idinen, die Geisterburg der Tuareg im N von Gat. Ausläufer des Akakus, Oberer Silurischer Sandstein. (1942)

Fig. 9. Idinen, citadel of the Tuareg ghosts north of Gat. Off-shoots of the Akakus, upper Silurian sandstone. (1942)



Abb. 10. Murzuk. Blick von dem alten Kastell nach S über die alte Moschee innerhalb der Außenmauer des Kastells. L. auf dem freien Platz standen die Kasernen und Depots der Italiener. Vor der Mauer lagen Salzsümpfe, die als Brutstätten der Malariamücken trokkengelegt wurden. Die breite Straße halbrechts vom Minaret ist der „Dendal", der zum Südtor führt. An ihm lag r. etwa in der Mitte der Sklavenmarkt. L. vom vorderen Minaret, in dem weißen Haus, soll Nachtigal gewohnt haben. Jetzt ist hier die Schule. Heute füllen die Häuser nicht mehr den Raum innerhalb der Stadtmauer. Im Hintergrunde die Dünen der Edeien von Murzuk. (1962)

Fig. 10. Murzuk. Southward view from the old citadel, facing the old mosque, lying within the outer walls of the citadel. On the left, on the open square, there used to the barracks and depots of the Italian occupiers. The salt-swamps in front of the wall have been dried up, because they had been breeding-places of the Malaria-mosquitoes. The broad street to the right of the minaret is the "Dendal", which leads to the South Gate. Near this street, there used to be the slave market. In the white house left of the nearer minaret, Nachtigal is said to have lived, now there is a school. Today, the houses do not longer fill the room within the city walls. In the background, you see the sand sea (Edeyin) of Murzuk. (1962)



Abb. 11. Edeien von Murzuk. Die hohen Dünen sind 100 bis 120 m hoch und werden durch sandige Senken (Gassi) voneinander getrennt, die durch niedrigere Dünen in einzelne Becken zerlegt werden. Es entsteht eine Gitterdünenwüste. Niedrigere Dünen ziehen über die hohen. (1937)

Fig. 11. Sand sea (Edeyin) of Murzuk. The dunes rise to a height of 300 to 350 feet and are separated by sandy passages (Gassi) which are subdivided in small basins by lower dunes, thus forming a gratelike dune desert. Lower dunes seem to divide the higher ones. (1937)

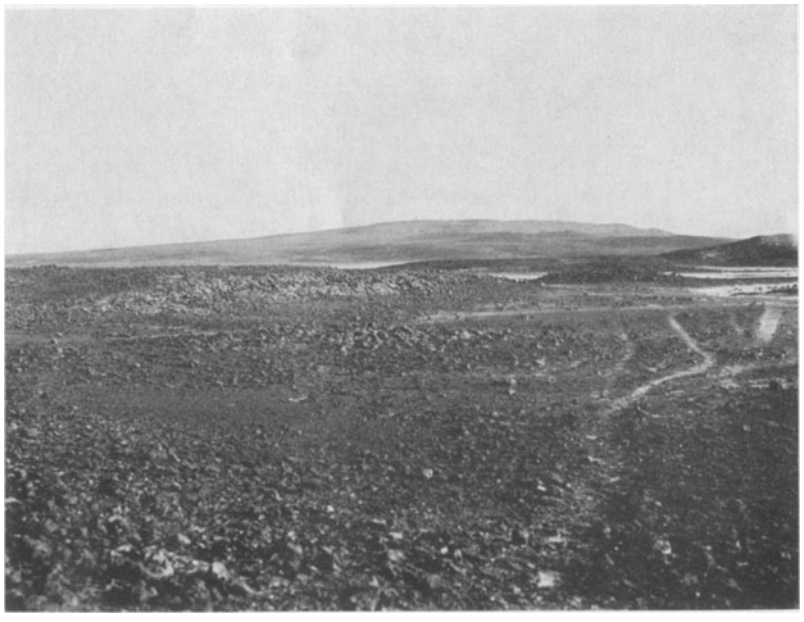


Abb. 12. Harudsch el Asued. Der Schildvulkan Garet ed Dem im W. Zwischen den Lavaströmen sind helle Verwitterungsprodukte abgelagert. In diesen kleinen Becken sammelt sich nach Regen zeitweise Wasser an. (1937)

Fig. 12. Haruj es Sauda. The shield volcano of Garet ed Dem in the West. Between the lava flows, you find light-coloured mantle rock sediments. After rainfalls, the small basins are temporarily filled with water. (1937)

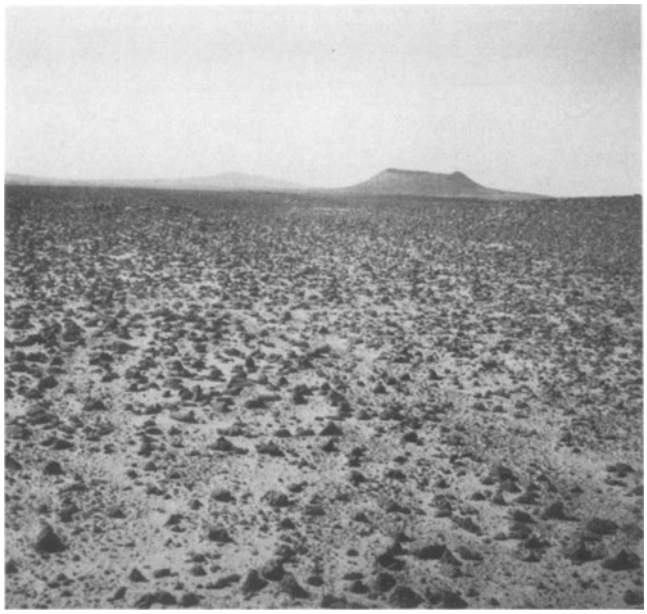


Abb. 13. Harudsch el Asued. Vulkane aus der Vulkanreihe Angud el Jeserat im SE des Harudschrandes. Lavasteinwüste im Vordergrund. (1964)

Fig. 13. Haruj es Sauda. Volcanos belonging to the Angud el Jeserat volcano chain in the South-East of the edge of Haruj. Lava-stone desert in the foreground. (1964)



Abb. 14. Das Inselgebirge Auenat. Westrand des Granitgebirges, davor eine für längeren Aufenthalt erbaute, mit Matten abgedeckte Tibbuhütte. Zwischen den Granitblöcken findet man r. Felszeichnungen. Hinter dem Sporn links liegt die Ain Zueia. (1958)

Fig. 14. The Jebel of Auenat. Western edge of the granitic mountains. In front of it: a Tibbu cottage, built for longer residence and covered with mats. On the right, you can find stone-drawings between the rocks. Behind the spur on the left, there is Ain Zueia. (1958)

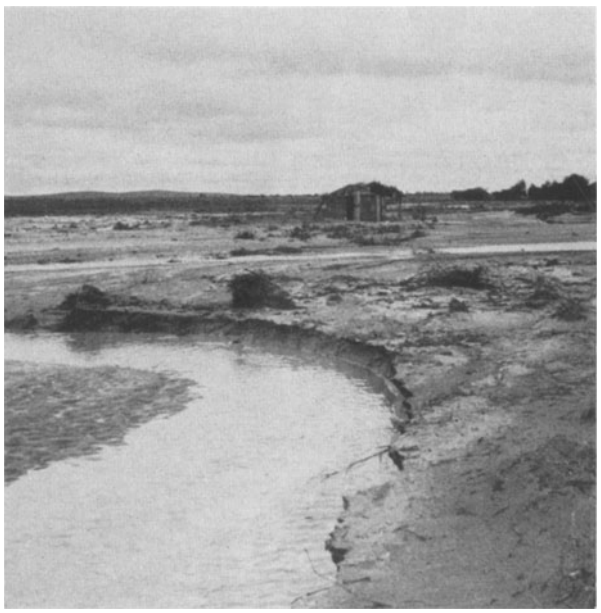


Abb. 15. Dschefara SE. Überflutung nach Regen am tripolitanischen Dschebel durch das Wadi Ulad Zaid an der Straße Tripolis-Tarhuna, nördlich von Ben Gaschir. (1965 Jan.)

Fig. 15. South-East Jefara. Inundations after rain in the Tripolitanian Jebel, caused by Wadi Ulad Zaid at the oad from Tripoli to Tarhuna, north of Ben Gashir. (1965 Jan.)



Abb. 16. Fezzan. Der See von Mandara (Durchmesser 300 m) in der Edeien von Ubari (Grundwasser), salzig, umgeben von Dattelpalmgürtel. In ihm leben Krebse und Mückenlarven. R. am Dünenhang im Hintergrund das Dorf Mandara. (1933)

Fig. 16. Fezzan: The Mandara Lake (diameter: 330 yds.) in the Ubari sand sea (Edeyin) (ground water), salty, surrounded by a date palm circle. Crabs and mosquito larvae are living in the lake. On the slope of the dune in the background, on the right, you see Mandara village. (1933)



Abb. 17. Kufra, See von Buema, Südufer. An den Wasserpflanzen links Salzausblühungen. Am Nordufer, etwa 4 m vom See, liegt ein Brunnen mit nur schwach brackigem Wasser. (1958)

Fig. 17. Kufra, Buema Lake, Southern lakeside. The water plants on the left show saline deposits. On the Northern lakeside, in a distance of about 4 yds., you see a well whose water is only slightly brackish. (1958)



Abb. 18. Fezzan: Murzuk. Kleiner Salzsee im Salzton (Grundwasser), dahinter die z. T. zerstörte Stadtmauer. Malariamücken! (Anopheles). Gesehen vom SW (1937)

Fig. 18. Fezzan: Murzuk. Small salt lake in the saline clay (ground water), behind it the city walls, partly destroyed. Malaria-mosquitos! (Anopheles.) Seen from the South-West (1937)



Abb. 19. Hamada el Hamra Ost. Galtet al Beda, Regenwassertümpel unterhalb der Steilwand des Wadi Zettar nördlich von Geriat es Schergia. (1933)

Fig. 19. East Hamada el Hamra. Galtet al Beda, rain water pool below the scarp of Wadi Zettar north of Geriat es Shergia. (1933)



Abb. 20. Fezzan: Becken von Fogha, im W der Harudsch. Quelle am Nordstrande des Beckens mit gestautem Quellteich, links Garten. (1937)

Fig. 20. Fezzan: The Fogha basin, west of it the Haruj. Spring whose water is dammed up in a pool in the northern part of the basin. On the left: a garden. (1937)



Abb. 21. Gadames. Artesische Quelle Ain el Fras. Der Quelltrichter ist mit einer Mauer umgeben und reicht tief in den Kalkstein. Das Wasser ist klar und sauber. Zwischen den Palmen erkennt man die hohen Gadameshäuser. (1962)

Fig. 21. Gadames. Artesian Spring of Ain el Fras. The reception basin is surrounded with a wall and goes deep down into the limestone. The water is clear and clean. Between the palm-trees you see some high Gadames houses. (1962)

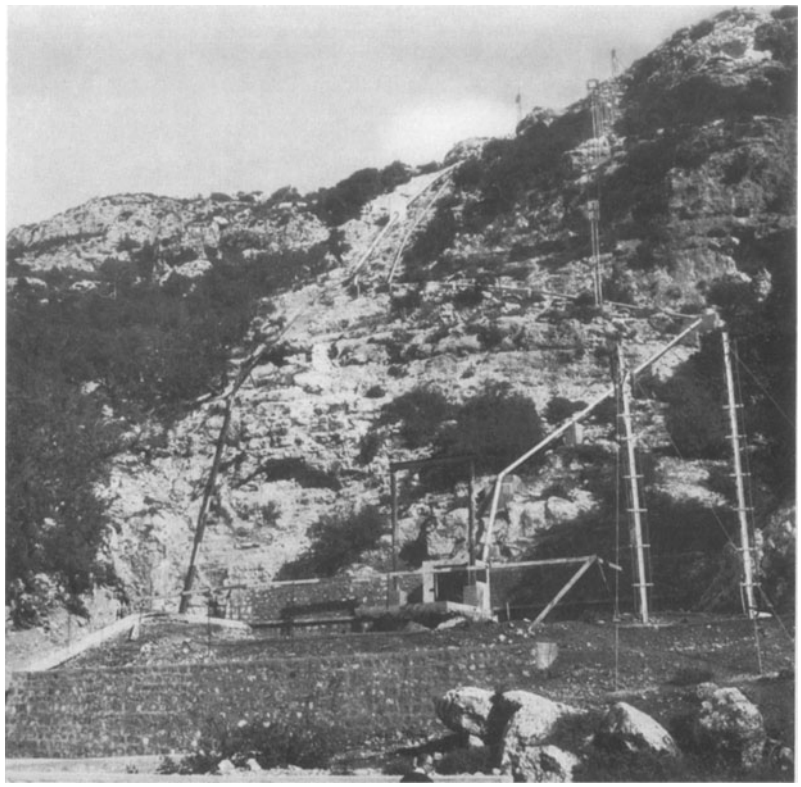


Abb. 22. Cyrenaica, Prov. Derna. Entnahmestelle der Karstquelle im Wadi Debussia, Nebenwadi des Wadi Latrun. Links die britische Leitung, rechts Mannesmannleitung. Das Wasser wird auf die Hochfläche gepumpt und über Beida bis Barce geleitet. (1965)

Fig. 22. Cyrenaica, Province of Derna. Tap of the intermittent spring in Wadi Debussia, side wadi of Wadi Latrun. On the left, the British pipeline, the Mannesmann pipeline on the right. The water is pumped up onto the tableland and conducted to Beida and then to Barce. (1965)

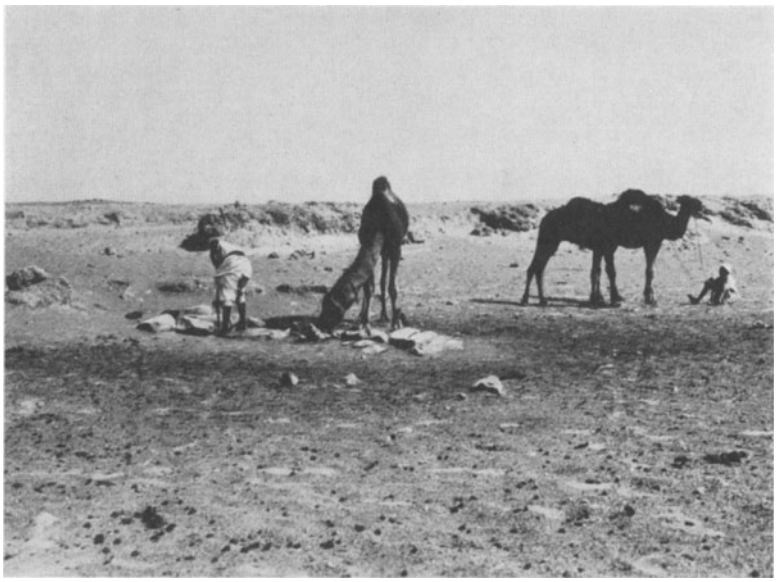


Abb. 23. Hamada el Hamra. Brunnen (der) Mellaha el Gibla. (1937)

Fig. 23. Hamada el Hamra. Well of Mellaha el Gibla. (1937)



Abb. 24. Fezzan: Neu angelegte Bewässerungspflanzung bei Dlem östlich Murzuk. Vor dem Auspflanzen der Palmsetzlinge mußte eine Salztonkruste von 5 cm entfernt werden. Die Reste der Salzkruste sind seitlich aufgehäuft. Brunnengerüst (Dalu) rechts im Hintergrund. (1933)

Fig. 24. Fezzan: New irrigated plantation near Dlem, east of Murzuk. Before setting the palm-layers, the soil has to be freed from a salt-clay crust of more than two inches. The remainder of the salt crust has been piled up on the side. In the background on the right, you see a framed well (Dalu). (1933)



Abb. 25. Kufra. Bewässerung eines Gartens mit Tomatenpflanzen. Feld für Feld wird aus dem Dalu unter Wasser gesetzt. Zaun aus Palmwedeln gegen Sandtreiben. (1958)

Fig. 25. Kufra. Irrigation of a garden with tomato plants. Each field is separately inundated with water from the Dalu. The fence, made of palm-branches, serves as a protection against sand storms. (1958)

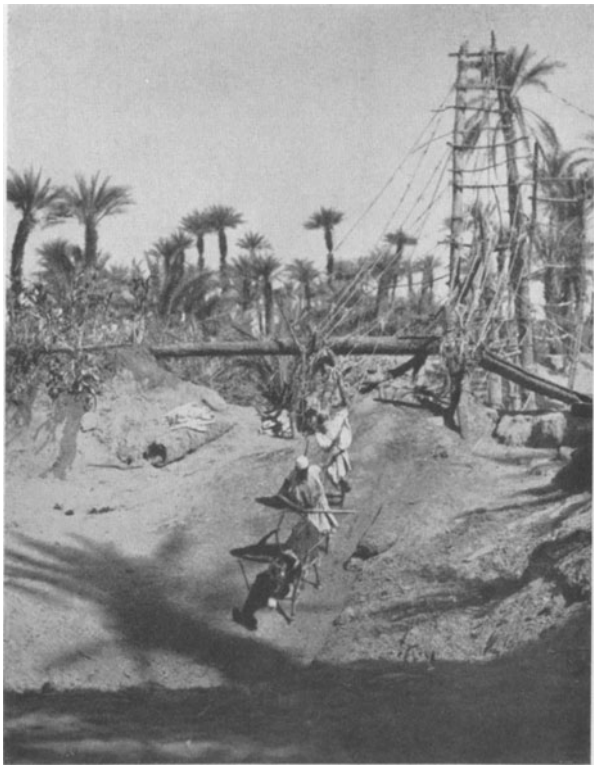


Abb. 26. Fezzan: Wadi Etba, w. von Murzuk bei Dudschal. Gerüst über dem offenen Brunnen (Dalu). Ausgehöhlte Palmstämme leiten das Wasser zu den Bewässerungsgräben der Gärten. Ein Esel und 2 Fezzaner ziehen das Wasser im Ziegenfellschlauch durch Herabgehen auf schiefer Ebene aufwärts. (1937)

Fig. 26. Fezzan: Wadi Etba, west of Murzuk near Dudjal. From the framework over the open well, hollow palmtree stems lead the water into the irrigation system of the gardens. The water is pulled up from the well in a goat-skin by a donkey and two Fezzan men, who are walking down an inclined plain. (1937)

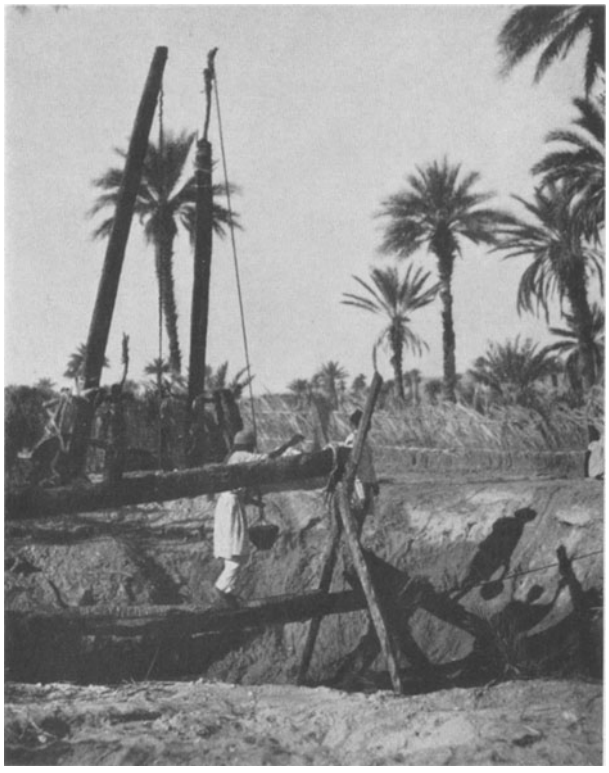


Abb. 27. Fezzan: Brunnen in Trona, Edeien von Ubari (Kettara). Mit Hebebalken und geflochtenem Korb (Palmfaser) wird das Wasser gehoben. Der Mann steht auf einem Balken über dem Wasser und gießt es in den ausgehöhlten Palmstamm. (1937)

Fig. 27. Fezzan: Well in Trona (Edeyin), Ubari sand sea (Kettara). The water is lifted by means of a heaver and a basket made of palm fibres. A man is standing on a beam over the water and pouring it into the hollow palmtree stem. (1937)



Abb. 28. Misda, vornehme Araberfamilie rechts mit 2 Söhnen. Die Kinder tragen die langen weißen Hemden, die Männer Hemden, darüber gestickte Westen, unter den Hemden lange weiße Hosen, gestickte Schuhe, den weißen Barrakan. Kappen, darüber roten Fes. Der mittl. Mann trägt in der Hand einen Fliegenwedel. (1937)

Fig. 28. Misda. On the right: noble Arab family with two sons. The children are wearing their long white shirts, the men wear shirts and embroidered waistcoats, long white trousers under the shirts, embroidered shoes, their white Barrakan. On their heads: caps with the red Fez. The man in the middle is holding a flyclap in his hand. (1937)



Abb. 29. Fezzan: Araber (Hemd, Barrakan), die beiden Knaben haben leichten Negereinschlag. Links Calotropis procera. (1933)

Fig. 29. Fezzan: Arabs (shirt, Barrakan), the two boys have a negroide touch. On the left: Calotropis procera. (1933)

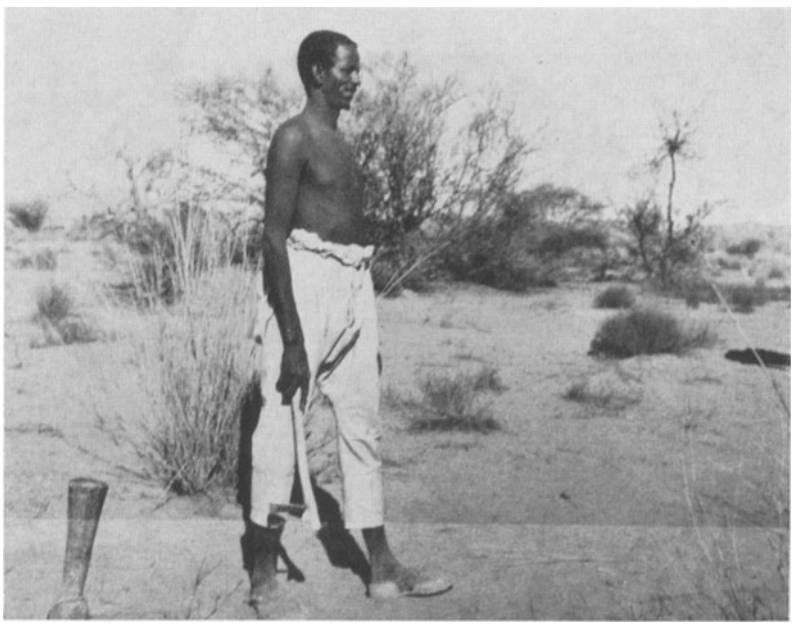


Abb. 30. Tibbu (Kuschi Moli), geb. in Zuar Tibesti, wohnt z. Z. in Kufra (1958), dunkelbraune Hautfarbe, glattes Haar, Spitzbart; Größe 1,80 m.

Fig. 30. Tibbu (Kushi Moli) born in Zuar Tibesti, at present living in Kufra (1958), darkbrown skin, straight hair, pointed beard, 1.80 m length.



Abb. 31. Fezzan: Gatrun. Tibbu. In der Mitte der Mudir von Gatrun, rechts und links Tibbu mit Barrakan (links zusammengefaltet übergeschlagen). (1933)

Fig. 31. Fezzan: Gatrun. Tibbu. In the middle: the Mudir of Gatrun, right and left: Tibbu with Barrakan (left: folded and thrown over the shoulder). (1933)

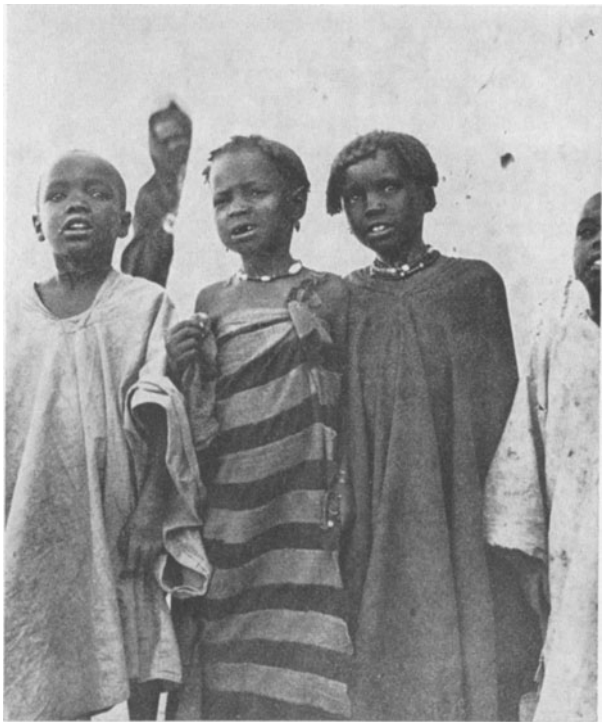


Abb. 32. Fezzan: Gatrun. Tibbu-Kinder. In der Mitte 2 Mädchen mit charakt. Haarfrisur der Unverheirateten. Tunica, Zöpfe an Seiten und nach vorn. Eine große Haarflechte geht von vorn aus längs Medianlinie des Schädels und endet im Nacken. Halsketten. Knaben, Haar abrasiert, Hemden. (1933)

Fig. 32. Fezzan: Gatrun. Tibbu children. In the middle: two girls with the typical hairdress of the unmarried girls. Tunica, braids at the sides and on the forehead. One big plat from the forehead to the neck. Necklace. Boys with shaved heads, shirts. (1933)

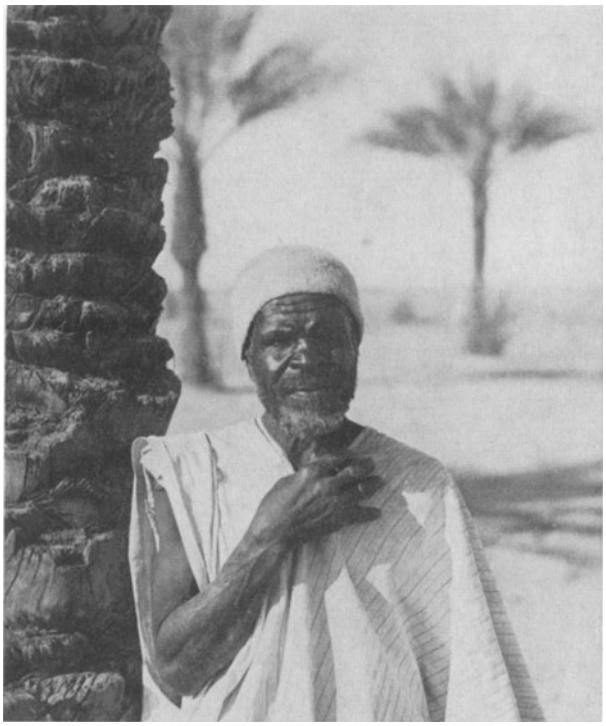


Abb. 33. Fezzan. Dlem. Capo des Dorfes, dunkelbrauner Fezzaner (mit Negereinschlag). (1933)

Fig. 33. Fezzan: Dlem. Capo of the village, dark-brown Fezzan man (with a negroide touch). (1933)

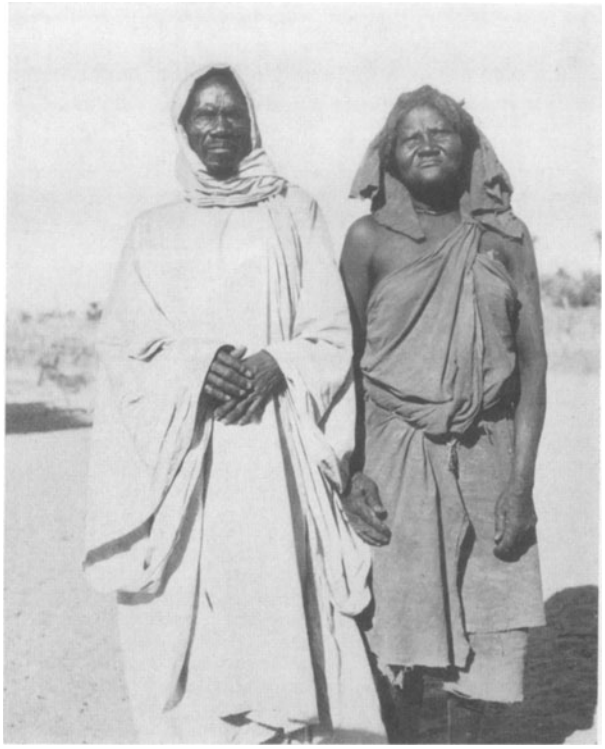


Abb. 34. Fezzan: Frau und Mann, Fezzaner, Mann fast schwarz, Frau dunkelbraun. Mann langes Hemd und Kopftuch, Frau zerschlissene Tunica und Kopftuch (Arbeitskleid). (1933)

Fig. 34. Fezzan: Woman and man. Fezzan type man nearly black, woman dark-brown. Man: long shirt and head scarf. Woman: tattered tunica and head scarf (working-dress). (1933)

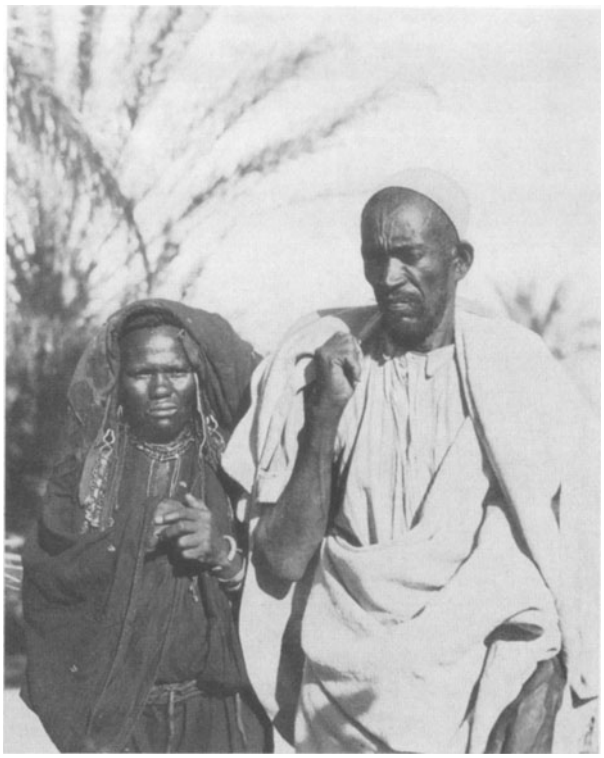


Abb. 35. Fezzan: Madschedul. Capo mit Frau, fast Negerin, trägt Schmuck. (1933)

Fig. 35. Fezzan: Madjedul. Capo and his wife, almost negress, wearing jewellery. (1933)



Abb. 36. Fezzan: Hammera. Knabe und Mädchen. Knabe weißes Hemd, Haarschopf bleibt beim Rasieren des Haares stehen (zum Anfassen durch den Engel, falls er beim Tode von der Brücke zum Paradies abstürzen sollte). Mädchen dunkle Tunika, Amulett auf Stirn, (beachte: Fliegen im Gesicht, besonders an Augen.) (1933)

Fig. 36. Fezzan: Hammera. Boy and girl. Boy: white shirt. A tuft of hair is left without shaving (in order that the angel might be able to seize him, if, after death, he should fall from the bridge to Paradise). Girl: dark-couloured tunica. Amulet on the forehead. (Note: flies in the face, especially around the eyes). (1933)



Abb. 37. Fezzan: Trona (Edeien von Ubari). Dauada (Fezzaner) Hosen, Barrakan, Sandalen, aus Palmfasern geflochtenes Gefäß, das Wasser enthält. (1933)

Fig. 37. Fezzan: Trona (Edeyin, Ubari). Dawada (Fezzan) trousers, Barrakan, sandals, container plaited of palm fibres, filled with water. (1933)



Abb. 38. Fezzan, Wadi Schegua. Hütten aus Palmwedeln (Seriba), oft nur zeitweise (Dattelernte) bewohnt. (1933)

Fig. 38. Fezzan, Wadi Shegua. Cottages made of palm branches (Seriba), a great number of which are inhabited only temporarily. (Date harvest period.) (1933)



Abb. 39. Fezzan: Gatrun. Tibbu-Zelt für vorübergehenden Aufenthalt. Geflochtene Matten über Holzgestellen aus Zweigen, tonnenförmig. Sättel und gekaufte Datteln auf Erde. (1933)

Fig. 39. Fezzan: Gatrun. Tibbu tent for temporary residence. Plaited mats over barrel-like racks, made of branches. Saddles and bought dates lying on the ground. (1933)



Abb. 40. Fezzan: Gatrun. Das neue Dorf aus Seriben, Palmwedelhütten (in Form des Tibbu-Zeltes) und Zäunen (Hof). Vor dem Kind liegt ein Haufen Datteln. Frau mit geflochtenem Korb auf Kopf. (1933)

Fig. 40. Fezzan: Gatrun. The new palm-branch village. Palm-branch cottages (same form as the Tibbu tent) and fences (courtyard). In front of the child: a heap of dates. Woman carrying a plaited basket on her head. (1933)

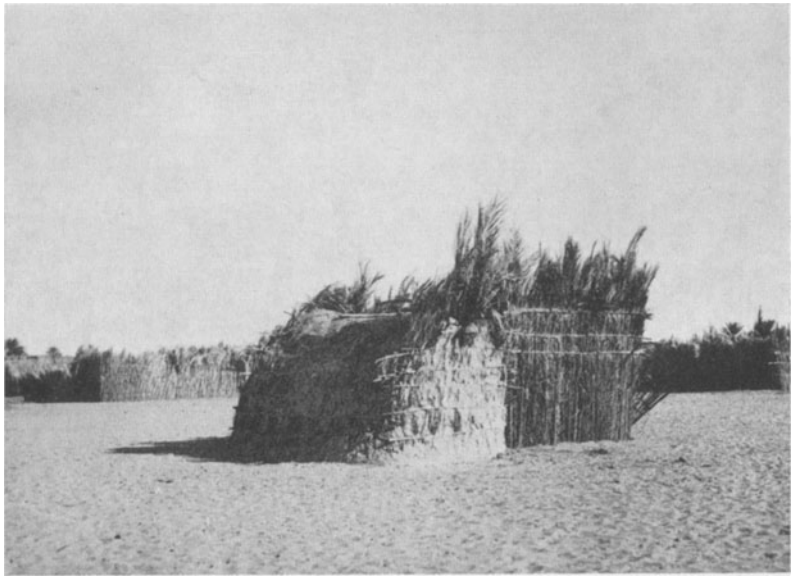


Abb. 41. Fezzan: Bacchi. Seriba als Dauerwohnung. Wohn- und Schlafraum mit Lehm beworfen, dahinter Hofraum. Die Tür ist nach außen gefallen. (1933)

Fig. 41. Fezzan: Bacchi. Palm-branch cottage as permanent residence. The living and sleeping room are roughcast with loam, behind: the courtyard. The door has fallen out. (1933)



Abb. 42. Fezzan: Tibbudorf Tegerhi (Tedscherri) Wadi Hecma. Bauten aus getrockneten Lehmziegeln, z. T. mit Lehm beworfen, meist ein gedeckter (Palmwedel mit Lehm) Schlafraum und ummauerter Hof. (1933)

Fig. 42. Fezzan: Tibbu village of Tegerhi Wadi Hecma. Houses made of dried loam tiles, partly plastered with loam, mostly a covered sleeping-room (palm-branches with loam) and a walled-round courtyard. (1933)



Abb. 43. Fezzan: am Uigh es Seghir. 2 Tibbu aus NW-Tibesti (Bardai), links Amulette am Kopf und Ziegenfellmantel, rechts trägt Speer. (1933)

Fig. 43. Fezzan: near Uigh es Seghir. 2 Tibbu men from North-West Tibesti (Bardai). Left: Amulets on the head, goatskin coat. Right: carrying a spear. (1933)



Abb. 44. Fezzan: Gatrun. Haarschnitt der verheirateten Frauen, vordere Zöpfe abgeschnitten, seitliche fallen über die Ohren. Über Stirn Haartürmchen. Schöne Tuniken, charakteristischer Schmuck. Nahmen Kopftuch zum Fotografieren erst ab, nachdem alle einheimischen Männer weggegangen waren. (1933)

Fig. 44. Fezzan: Gatrun. Haircut of the married women: The plats on the forehead have been cut, the ones on the sides fall over the ears. Small hair towers over the forehead. Beautiful and typical jewellery. When asked to take off the head scarf for the photo, they waited until all the native men had gone. (1933)

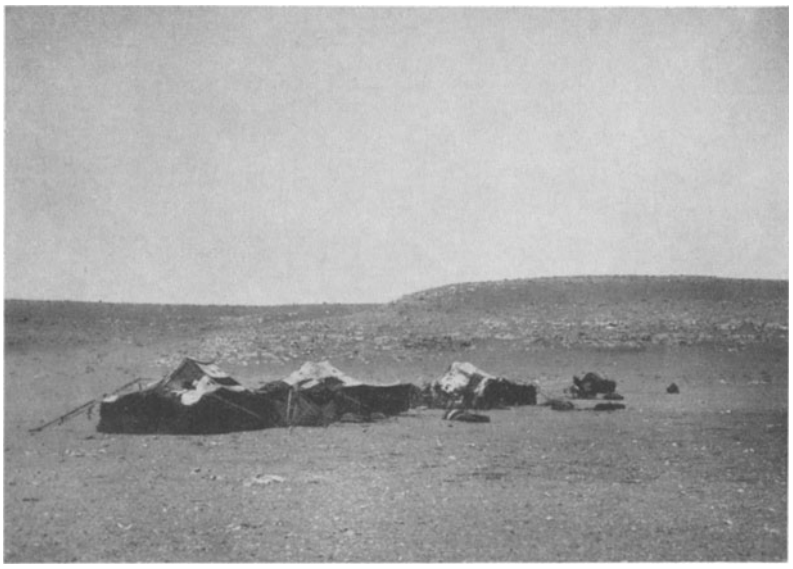


Abb. 45. Nordwestlich von Hon: Zeltlager der Araber nahe dem Bir Regil, Zelte geflickt, schwarz und weiß. (1933)

Fig. 45. North-West of Hon: Tent camp of the Arabs near Bir Regil. The tents are mended, black and white.



Abb. 46. Bu Ngem. Araberzelte am Rande der Oase. Zeltbahn über Mauern gezogen. (1958)

Fig. 46. Bu Ngem. Arab tents at the marge of the oasis. The tent square is pulled over walls. (1958)



Abb. 47. Fezzan: Dorf Birghen (Wadi es Schati). Die meisten Häuser mit Obergeschoß, ummauerter Hof, weiß getüncht (Gips). (1933)

Fig. 47. Fezzan: Birghen village (Wadi es Shati). Most of the houses have a second floor, whitewashed (gypsum), walled-in courtyard. (1933)



Abb. 48. Tobga, Wadi Zemzem. Wohnhöhlen, in den Kalkmergel des Berges gebaut, darüber feste Kalkschicht, z. T. auch freistehende Mauern und Häuser aus Kalkstein, der turmartige Aufbau mit Mauer: Senussia-Schule und Kloster. (1937)

Fig. 48. Tobga, Wadi Zemzem. Living-caves, built into the lime-marl of the mountain, over it solid lime stratum, partly detached walls and houses made of limestone. The tower-like construction with the wall is the Senussia school and monastery. (1937)



Abb. 49. Fezzan: Hammera (Hofra es Schergia). Frau: Hemd, Tunica und Kopftuch, in der Hand Sichel zum Fruchtschneiden. Junger Mann, langes weißes Hemd über weißer Hose, weißes Kopftuch, jüngerer Knabe, charakterist. langes Hemd für Knaben. (1933)

Fig. 49. Fezzan: Hammera (Hofra es Shergia). Woman: shirt, tunica, and head scarf, carrying a sickle to cut the crop. Young man: long white shirt over white trousers, white scarf. Jounger boy: characteristic long shirt for boys. (1933)



Abb. 50. Fezzan: Hammera. Frau mit Kind. (1933)

Fig. 50. Fezzan: Hammera. Woman with child. (1933)

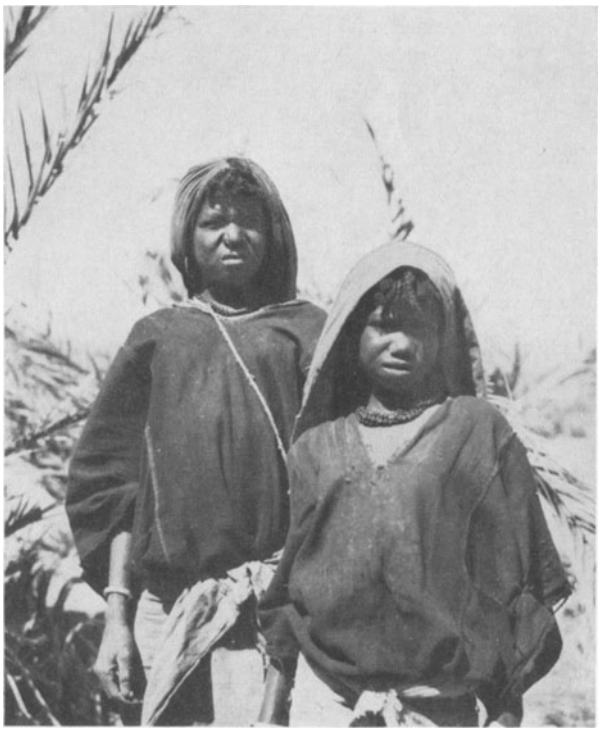


Abb. 51. Fezzan: Traghen. 2 Mädchen, schwarz, dunkle Tunica, Kopftücher, zur Arbeit über Unterleib und Beine eine Art Sackleinwand gebunden, links große Ohrringe, Armband, rechts Halskette. (1933)

Fig. 51. Fezzan: Traghen. 2 girls, black, dark tunica, head scarfs. As a working dress they are wearing a piece of sack-cloth around the hips and legs. Left: great ear-rings, bracelet. Right: necklace. (1933)



Abb. 52. Fezzan: Edri, Wadi es Schati. Blick von der zerstörten Burg (Dorfhügel) auf die engen gewundenen Gassen, die Lehmdächer der Schlafräume, die mit Palmwedeln gedeckten Höfe, stellenweise ein palmgedecktes Obergeschoß (rechts). (1933)

Fig. 52. Fezzan: Edri, Wadi es Shati. View from the ruin of the castel (village hill) on the narrow, winding streets, the loam roofs of the sleeping-rooms, the courtyards which are covered with palm-branches, from time to time a palm-covered upper floor (on the right). (1933)

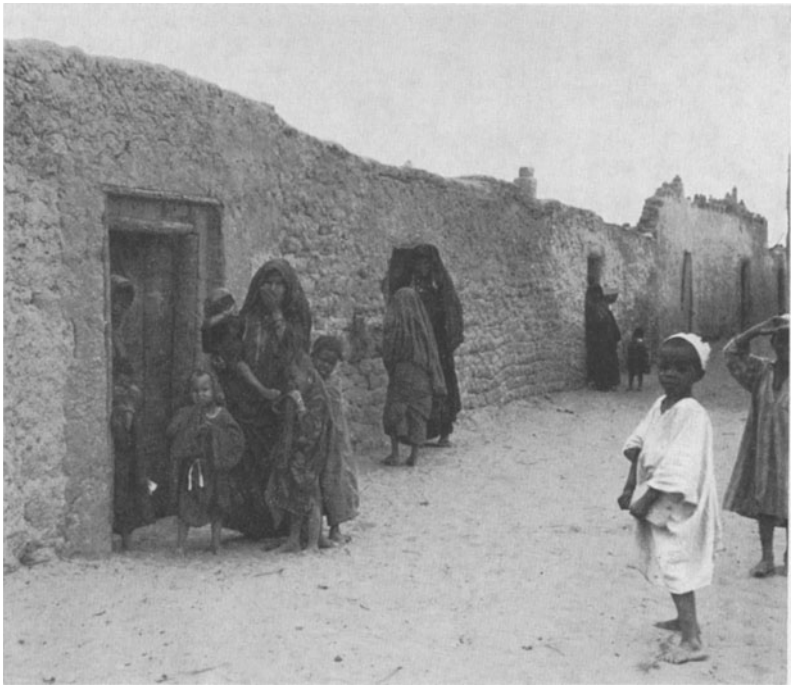


Abb. 53. Fezzan: Gasse in Um el Araneb. Jede Tür führt in einen Wohnhof, der von den Nachbarn völlig abgeschlossen ist. Vom Hof gelangt man in einen gemauerten und gedeckten Raum, der zum Schlafen dient und an die Außenmauer und Mauer zum Nachbarn angelehnt ist, daran anschließend nach rückwärts ein Raum aus Palmwedeln, dann die Küche, hinten ist noch ein kleiner Pferch für das Vieh und der Abort. Die Frau vorn hält das Gesicht zu wegen des Fotografierens. Man beachte die Zahl der Kinder! (1958)

Fig. 53. Fezzan: Small street in Umm el Araneb. Each door leads to a living-yard, which is completely separated from the neighbourhood. From the courtyard, you go into a covered room with stone walls, which serves as a sleeping-room and leans against the walls of the neighbouring house. Backwards, there is a palm-branch room, then the kitchen, behind it a small perch for the animals and the toilet. The woman in the foreground is sovering her face with her hands while the picture is taken. Note the number of children. (1958)

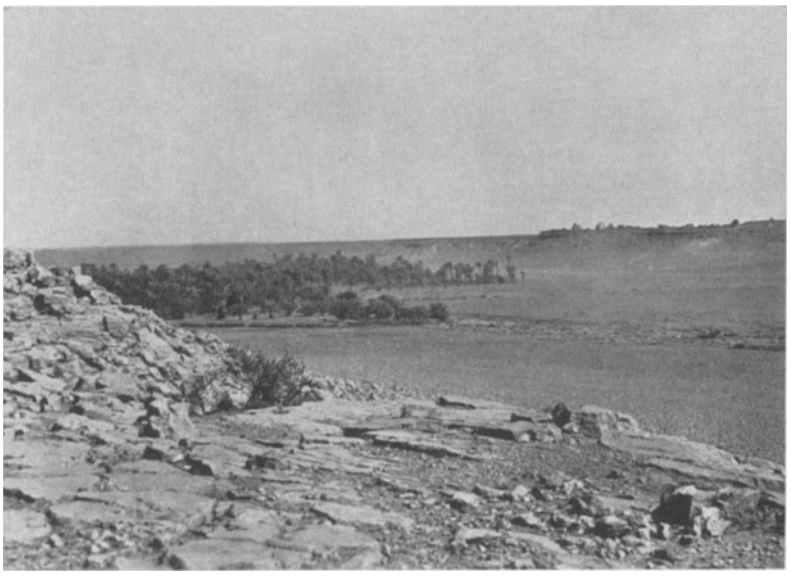


Abb. 54. Geriat el Garbia. Dorf über Wadi Zemzem und Lage außerhalb des Palmhaines. Hamada el Hamra. (1937)

Fig. 54. Geriat el Garbia. Village above Wadi Zemzem, situation outside of the palm grove. Hamada el Hamra.



Abb. 55. Geriat el Garbia. Reste des alten Römertores, z. T. im Schutt versunken. (1937)

Fig. 55. Geriat el Garbia. Ruins of the old Roman gate, partly sunk in rubble. (1937)



Abb. 56. Garian. Höhlenwohnung Tigrinna, tripolitanischer Dschebel. Berberischer Wohnhof, Eingang in Wohnraum links, rechts die Küche, unten Gipsmergel (weißgrünlich), darüber rotbrauner Ton (Löß). Es fehlt über dem Mergel die meist vorhandene Kalkkruste. (Es fehlen über den Wohnräumen die oft vorhandenen Eingänge zu Speichern) (s. Bild 58 gleichsam versenkter Hof!). (1937)

Fig. 56. Garian. Cave house Tigrinna, Tripolitanian Jebel. Berber living-yard, entrance to the living-room on the left, the kitchen on the right, white-green gypsum-marl on the floor covered with red-brown clay (loess). The generally used lime crust over the marl is lacking here. (Over the living-room, there are no doors leading to storage-rooms, which are often found.) (See Fig. 58.) (1937)



Abb. 57. Garian: Höhlendorf über Tigrinna. Eingänge zu den Wohnhöhlen, im Mittelgrund das große Loch, gibt Blick frei in einen Wohnhof (unerwünscht!). (1937)

Fig. 57. Garian: Cave village above Tigrinna. Entrances to the Living-caves, in the centre: the big hole which opens the view into the living-yard, (not desired!).

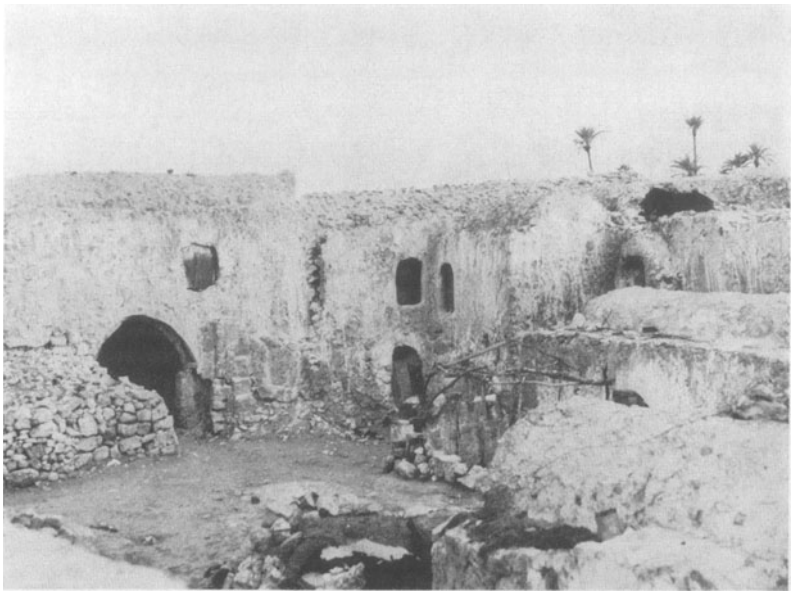


Abb. 58. Misda, unteres Dorf. Häuser mit Tonnendach, stehen um Hof, der durch Tor zugänglich (links). Die oberen Räume dienen im allgemeinen als Speicher (Wandlöcher). Haus entspricht in der Anlage einer Höhlenwohnung (s. Abb. 56). (1937)

Fig. 58. Misda, lower part of the village. Houses with barrel-like roofs standing around the yard which can be entered by the gate on the left. The upper rooms generally serve as storage-rooms (wall-holes). In its construction, this house corresponds to a cave-house (see Fig. 56). (1937)



Abb. 59. Misda, ges. von E. Mittelgrund Reihe von Tonnendachhäusern. Ältere Türme für Rückzug bei Streit der Familien. Im Hintergrund auf Berg das ehemalige italienische Fort. (1937)

Fig. 59. Misda, view from the East. In the centre: row of houses with barrel-like roofs. The ancient towers serve as help for retreat in family feuds. On the mountain in the background, the former Italian Fort. (1937)



Abb. 60. Syrte, Marktstraße. Italienischer Einfluß auf die Bauweise. (1962)

Fig. 60. Sirte, market street. Italian influence on the method of construction. (1962)



Abb. 61. Tripolis: Blick von der Mauer an der Porta el Gedid in die Sciarra Homet Garian. Altstadt, mehrstöckige Häuser, Höfe, Flachdächer, enge Gassen. (1957)

Fig. 61. Tripolis: View from the wall at the Porta el Gedid into the Sciarra Homet Garian city, facing multy-storey houses, courtyards, flat roofs and narrow streets. (1957)

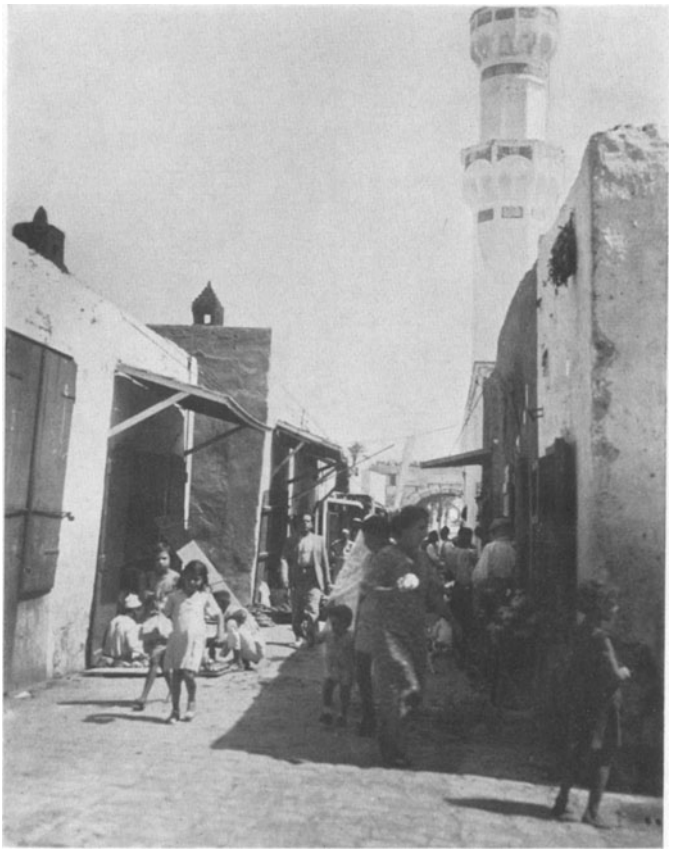


Abb. 62. Tripolis: Sciara Hara Kebira mit Läden, im Hintergrund der Triumphbogen des Marc Aurel. Altstadt. (1957)

Fig. 62. Tripolis: Sciara Hara Kebira with shops, in the background: the triumphal arch of Marc Aurel. Old part of the town. (1957)



Abb. 63. Tripolis: Sciarra Bagdad. Die jetzt fast ganz von Arabern bewohnte Straße zeigt ganz italienische Bauweise. (1962)

Fig. 63. Tripolis: Sciarra of Baghdad. The street, which is now almost exclusively inhabited by Arabs, shows an entirely Italian method of construction. (1962)



Abb. 64. Cyrenaica, el Beida, die neue Beamtenstadt, gesehen von SE. Moderne Wohnhäuser. Hochfläche des Dschebel Achdar. (1962)

Fig. 64. Cyrenaica, el Beida, the new town for the civil servants, seen from the South-East. Modern apartment houses. Tableland of the Jebel Akhdar. (1962)

Erklärung der arabischen Bezeichnungen in den Karten und im Text

Explanation of the Arabic Designations in Maps and Text

deutsch/German	*englisch/English*	*deutsch/German*	*englisch/English*
Ain, Ein	Ein, Ain (pl. Uweinat)	Quelle	spring
Bir	Bir (pl. Abiar)	Brunnen	well
Dahar	Dahr, Dahar	Tafelland	table land
Dschebel	Jebel, Gebel	Berg, Gebirge	mountain
Edeien	Edeyin, Idehan	Dünenwüste, Dünenmeer	sand sea
Erg	Erg	Dünen	dunes, dune field
Gara	Gara (pl. Gur)	Hügel, Erhebung, isolierter Hügel, niedriger Berg	hill (usually low)
Galtet	Galtat	Wasserloch	water hole
Gassi	Gassi	langgestreckte, vielfach breite, mit sandiger Serir bedeckte Hohlformen („Gassen") zwischen langen Dünenzügen	long, often broad passages covered with sandy Serir, separating long dunes
Grara (Graret)	Grara, Graret	flache geschlossene Senke	depression
Hamada	Hamada	Ebene mit groben Steinen und Blöcken	rock flat (story plain) covered with big stones and rocks
Hattia (Hattien)	Hattia, hatiet (hatia) (pl. hatiets)	Senke mit Vegetation und Vegetationsgebiet um Oase (vielfach Kupsten mit Büschen)	area of vegetation around oasis (often remainder of blown-off sand dunes, covered with bushes)
Marsa	Marsa	Hafen	harbour
Ramla (Ramlet)	Ramla (Ramlet)	Wüste aus grobem Sand mit Rippeln mit einigen wandernden Dünen aus Feinsand	coarse sand desert, often with wandering dunes of fine sand
Sebka (Sebkhet) *	Sebka (Sebchet) * (pl. sebkh)	Salzpfanne, Salztonfläche *	salt, marsh *
Serir	Serir	Ebene mit grobem Sand, Kies, Steine bis kirschgroß, auch noch gröber, aber dann oft verkieseltes Steinpflaster	gravel desert plain with coarse sand, gravel, stones up to the size of cherries, even bigger, but then pebble-stones
Tmed	Tmed (pl. Tumud)	Wasserloch (gefüllt mit Sand oder Steinen)	water hole (filled with sand or stones)
Wadi	Wadi (pl. Widien)	Trockenbett, Trockental eines Flußlaufes	water course desiccated river-bed
Zauia, Zawia	Zawia, Zauia	Stützpunkt der Senussi zwecks Ausbreitung ihrer Lehre	monastery religious centre

Abkürzung

Mh.: Angabe in Meereshöhe

Abbreviation:

Mh.: above sea level

*** Anmerkung:**

In der Karte 17 ist der Umfang einer Sebka durch eine unterbrochene Umrandung gekennzeichnet.

*** Note:**

In Map 17, the extend of a sebka is marked by a broken borderline.

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