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THE JEBEL GARIAN IN TRIPOLITANIA  
A REGIONAL STUDY

By

M.A. Khuga

Thesis submitted for the degree of M.Litt of  
the University of Durham, December, 1960.

PREFACE

This thesis has been prepared during the past two and a half years for submission for the degree of Master of Letters in the University of Durham.

The selection of the subject was based on my desire to acquire more detailed knowledge of the various problems of the semi-arid regions of the Tripolitanian Jebel. These regions are little known and in the light of Libyan development the need for detailed regional studies is essential. The regional approach is vital to the understanding of the varied economic and human problems of the country.

A word is necessary to explain my usage of certain terms. I have used the expression "Jebel" to indicate the whole of the Jebel Garian whilst the terms Asabaa, Orban and Guasem refer to separate parts of the Garian plateau. The terms Al Guasem, Al Orban and Al Asabaa, refer to the administrative districts of the Jebel Garian. Elsewhere, I have used local Arab and Berber words which I have written in phonetic English.

My research was based on personal travels and investigations amongst the sedentary and semi-nomadic tribes of Garian during an 8 month period of field work.

In conclusion, I wish to record my grateful acknowledgment to Professor W.B. Fisher, who accepted me as a postgraduate research student in the Department of Geography in the Durham Colleges. I am also indebted to Dr. J.I. Clarke for his generous supervision and continuous assistance, because without his

encouragement it would have been difficult for me to prepare my thesis.

I also wish to thank Dr. S.G. Willimott and Mr. D. Gilchrist Shirlaw who analysed my soil samples, and the many institutions and people in Durham and Libya who have given me every kind of help.

M.A. Khuga.

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Rain Days per Annum, Bu Maad.

Mean Monthly and Annual Rainfall, Al Asabaa.

Rain Days per Annum, Al Asabaa.

## Appendix II.

Garian District, Age Structure by Sex.

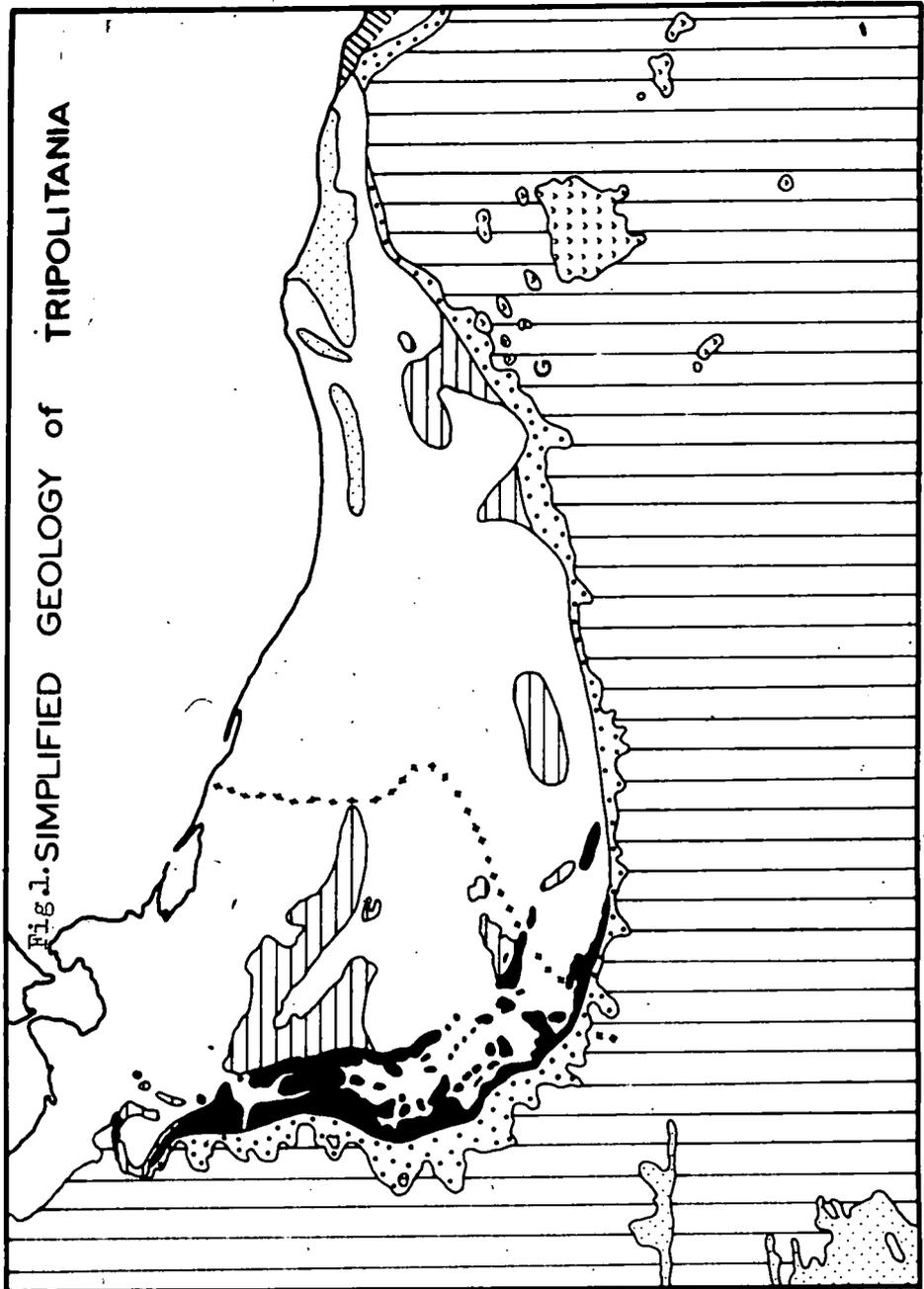
Marital Status by Age and Sex.

## INTRODUCTION

Libya is a large country in North Africa, which covers about 1,750,000 square kilometres. According to the Census of 1954, the total population is only 1,109,830, and it contains three main regions; Tripolitania to the west; Cyrenaica to the east; and Fezzan to the south.

The Cyrenaican Plateau is composed mainly of Tertiary limestones, which run in a crescent following the coast for about 250 kilometres. The maximum width is 50 kilometres and it reaches an elevation of about 850 metres above sea-level near its central point. The Fezzan on the other hand is a depression which contains major oases. Tripolitania is the most advanced region in Libya and the majority of the population of the country is concentrated in its coastal zone. The most significant feature in Tripolitania is the extension of uplands whose importance is increased by the slightly uptilting nature of the plateau edge and the occurrence of lava effusives. These uplands form the Tripolitanian escarpment which stretches from Matmata in Tunisia to Homs in Tripolitania, a total distance of some 650 kilometres. The Jefara plain lies between the coast and the escarpment and its significance lies in the fact that it is the deposition zone for the catchment area of the escarpment, whose wadis spread sands and detritus over much of its breadth. The escarpment is an impressive feature, since it is breached, gullied and ravined by innumerable wadis giving it a scalloped appearance, with numerous projecting spurs. The altitude is great in the

Fig. 1. SIMPLIFIED GEOLOGY of TRIPOLITANIA



-  DUNES
-  QUATERNARY
-  VOLCANIC
-  MIOCENE
-  U. CRETACEOUS
-  L. CRETACEOUS
-  JURASSIC
-  TRIASSIC

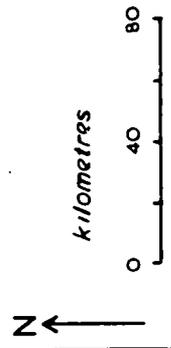


FIG. 2. THE JEBEL GARIAN: LOCATION

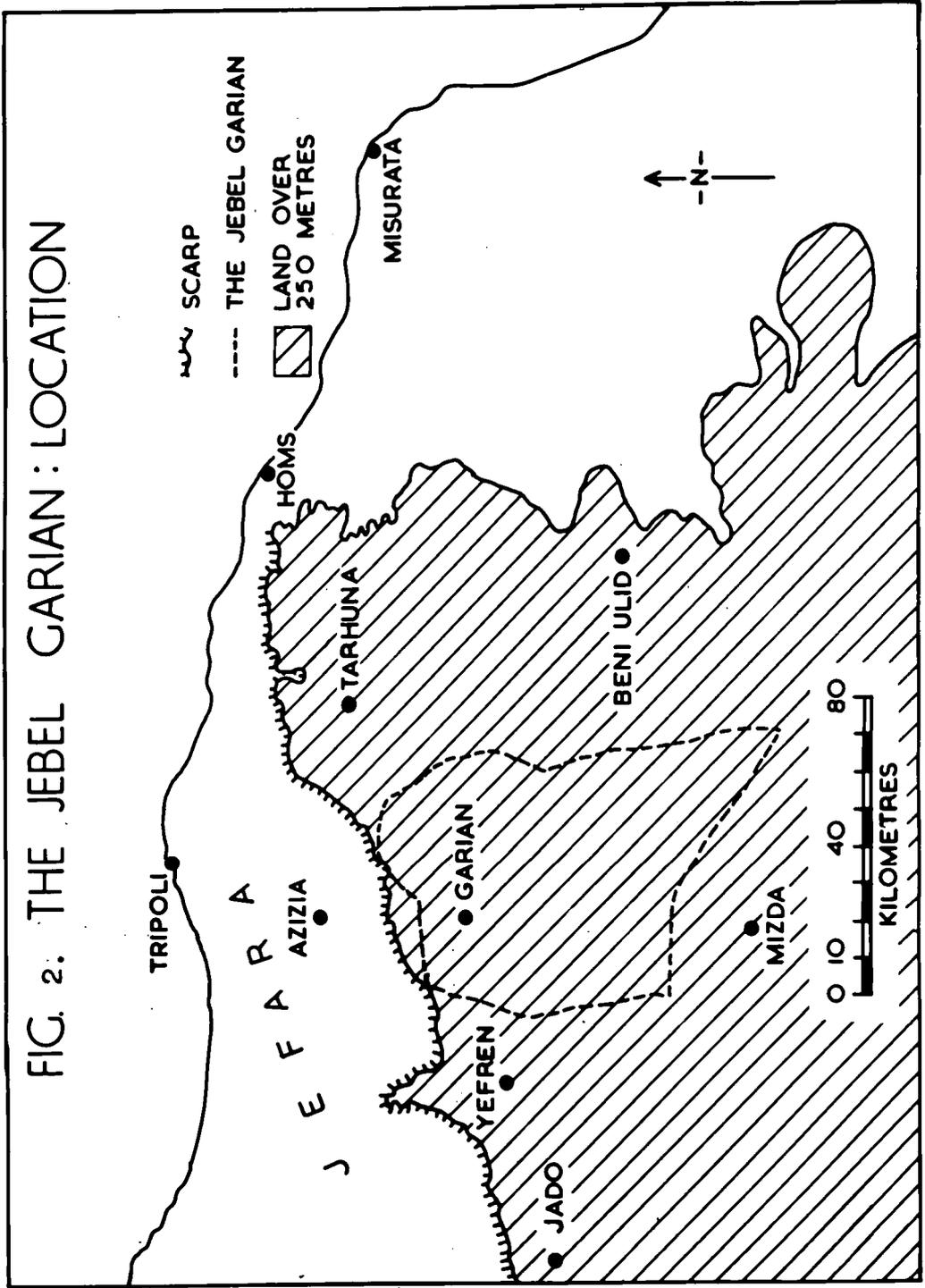
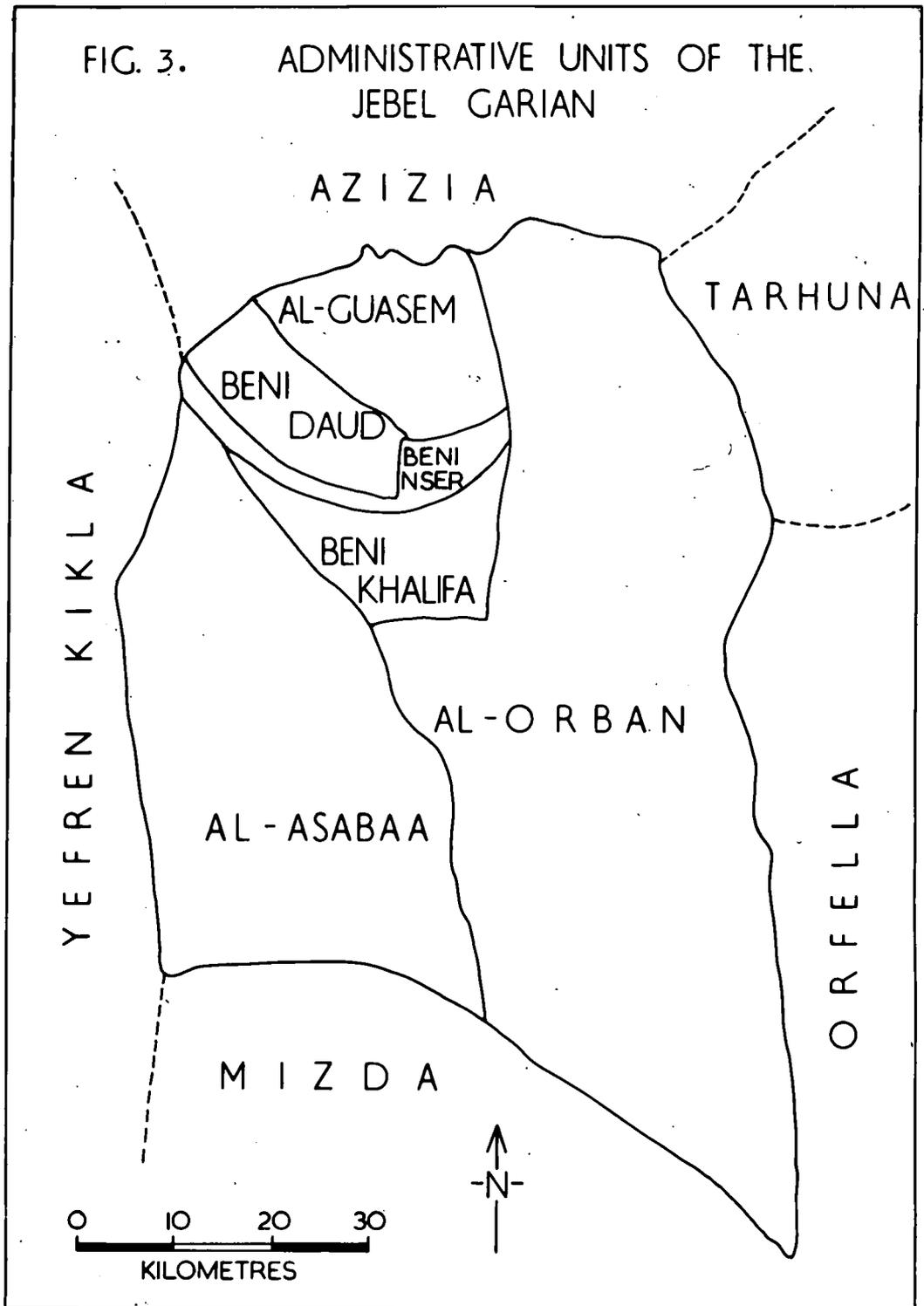


FIG. 3. ADMINISTRATIVE UNITS OF THE JEBEL GARIAN



central part of the escarpment, but it declines considerably to the east. South of the Tripolitanian escarpment is a stony plateau, hamada, mainly composed of red sandstone partly karstic and frequently overlain by basaltic outflows, some of which form imposing highland ridges.

The geological structure of the Tripolitanian escarpment, known as the Jebel, is Secondary (Triassic, Jurassic and Cretaceous) whilst the structure of the Jefara is fundamentally Miocene and Quaternary. Figure (I) shows the simplified geology of both the Jebel and the Jefara.

The Jebel Garian is a small section of the Tripolitanian escarpment, lying in the central zone of it, between the Jebel Nefusa to the west and the Jebel Tarhuna to the east. It has an area of 80,000 square kilometres, approximately limited by Wadi Zaret to the west and Wadi El-Hammam to the east. Wadi Tfalgo defines the region southwards, whilst the Jefara limits it to the north. Figures 2, 3 show the location of the Jebel and its administrative units. The total length of the northern boundary is 65 kilometres; the eastern is 112 kilometres; the western 70 kilometres; and the southern boundary is 80 kilometres.

The region is an uplifted zone which slopes gently to the south, the dip being emphasized by the upper limestone escarpment which has been covered in parts by diverse newer sediments. The region may be divided into the Jebel proper and the Ghibla. (See fig.15.) The former includes vast plateaux of Tigrinna and Guasem, and major wadis which flow down into the Jefara and Gattis.

This zone contains the most fertile and potentially good agricultural lands in the whole region. The Ghibla which commonly takes the form of a dissected plateau, is a very large zone where shifting cultivation and pastoralism are being practised by the semi-nomads of Al Asabaa and Al Orban. The limit of olive plantations forms the real boundary between the Jebel proper and the Ghibla.

This physical division corresponds with the climatic, vegetative and human features of the region. The climatic conditions represent a transition from the semi-aridity of the north to the more complete aridity of the south. Consequently, the vegetation varies between the humid esparto grass area in the north and the dry southern zone of sparse grass cover. The population of the Jebel proper is mainly Berber in origin, whilst Arab elements are dominant among the Ghibla people. Economically, the north is agricultural, while the south is pastoral.

The Jebel Garian as an integral part of Tripolitania has played an important role since the era of the Carthaginians and the Phoenicians, as the Jebel Garian lay across the main caravan routes which gave access to the Fezzan and to West Africa. When the Romans occupied Tripolitania in 46 B.C., they made considerable efforts to develop the mountainous areas and to overcome the problem of nomadism. Neither during the Arab occupation, nor during the Turkish conquest was any serious effort made in this region to develop agriculture; on the contrary nomadic activities increased in this period.

When the Italians occupied Libya in 1911, they did not develop the agricultural potential of the area immediately and it was not until 1933 that political stability was sufficiently assured to permit exploitation. In that year the Italian Government granted A.T.I. (Azienda Tobacchi Italiani) a concession in the Jebel. Tigrinna plateau was chosen as the best agricultural area. The A.T.I. commenced its work by surveying, then controlling the Berber lands; in toto giving the owners only slight compensation. As a result, both Beni Daud and Beni Nser were expelled by the Italian agency. In addition A.T.I. controlled Jauduba land in the north of Al-Asabaa Mudiriyat. The Agency intended to expropriate further lands in Beni Khalifa and Al-Guasem, but the outbreak of the Second World War prevented the Italians from completing this project.

The British Administration of Tripolitania (1943-51) was a transitional period and the Jebel people enjoyed greater freedom, one result of which was the return of exiles from Tunisia and Egypt who again took their part in the life of the cabila.

After Libya became independent in 1951, the Italian settlers were given the choice of maintaining their farms or handing them over to the Administration of Tripolitania. Most of them left and only 32 families remained.

As we have seen from the discussion of the broad lines of the agricultural history of the Jebel, the region was a favoured zone for agricultural expansion in both Roman and Italian times, and showed particularly great adaptability under the demographic

system of settlement. This is due to the following physical and human factors:-

- (1) The intermediate position of the region between Jefren and Tarhuna, and between the steppes of the Jefara and the Ghibla and the Fezzan, to the south, which gave the region an importance as a communication centre.
- (2) The variation of relief between the gentle plateaux and the slopes and broad, deep wadis is a significant feature for both agriculture and pastoralism.
- (3) The climatic conditions are to a large extent favourable for human settlement since the altitude, which attains over 800 metres above sea-level, sensibly reduces summer temperatures.
- (4) The vegetation cover of the region tends to occur in distinct zones, as for instance in the case of the esparto grass which is found in the upper wadi depressions in Orban.
- (5) Precipitation and the supplementary underground water resources and cisterns are sufficient for the cultivation of crops for domestic consumption.
- (6) The agricultural potential of the area is high since the soils of the Jebel are less sandy in nature than those of the Jefara. The soil is heavier in texture and richer in nutrient content.
- (7) The agricultural economy of the region combines both sedentary agriculture, shifting cultivation and pastoralism.
- (8) The human groups are mostly Berber in origin who are well advanced in agricultural techniques, and have a highly independent character.

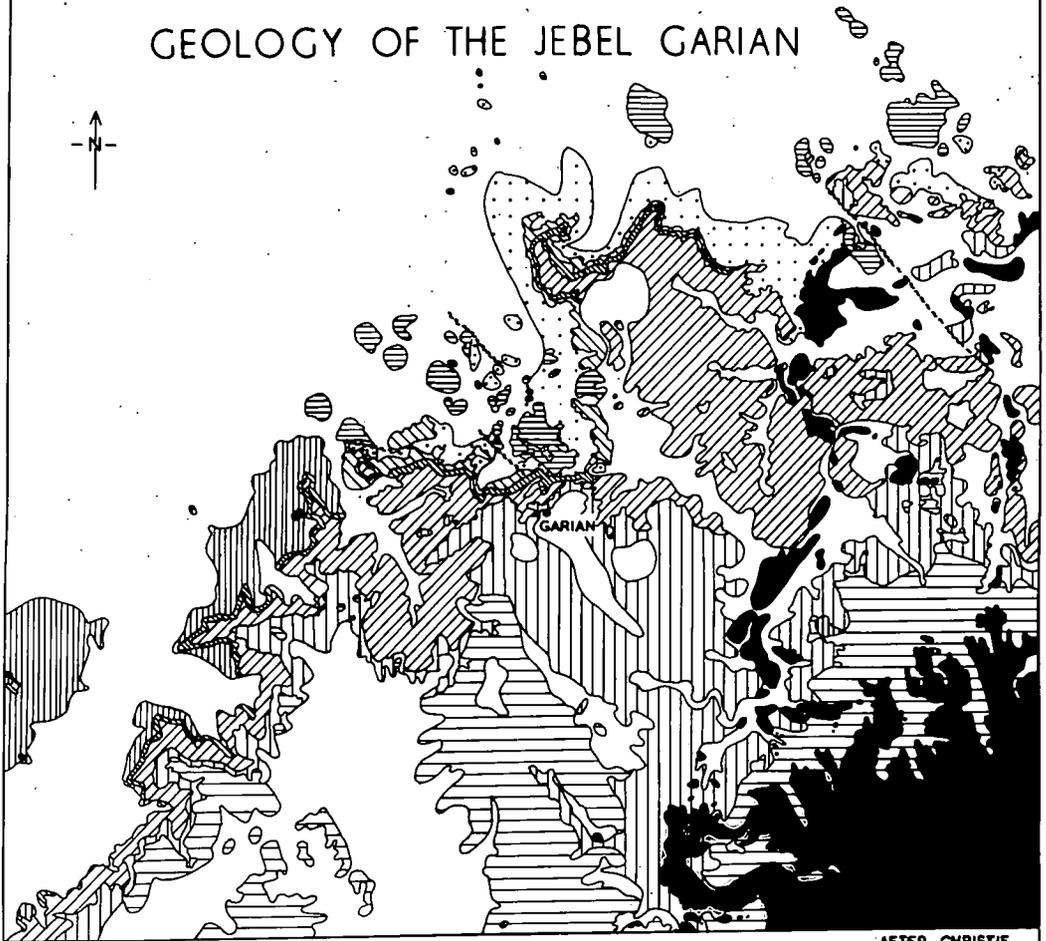
- (9) The Jebel is suitable also for the extension of dry-land static farming, which has already succeeded in some areas of the region.
- (10) The morphological features of the mountain landscape are favourable for crops such as tobacco, which require sheltered areas for protection from strong winds.
- (11) The region may be developed primarily in olives and secondarily in commercial crops such as tobacco and esperto.
- (12) The region is an extensive one, and may be expected to sustain more people than it does at present. The demographic estimates in the Jebel have shown that the area can support at least 8,000 if Al-Asabaa and Al-Orban were developed for static farming.

Although these general considerations stimulated my desire to make further regional studies, there were several obstacles which made work difficult, for example inaccurate data and lack of agricultural statistics. This was partly due to the fact that many of the Italian reports were transferred to Italy at the beginning of the Second World War. Moreover, the indigenous peoples always hesitate to give information about their farms and families since they fear that such details may be given to the Government.

In spite of these minor problems, I was able to gather the necessary material for this work. I have divided my thesis into three parts; in the first part I shall deal with the environment; in the second with the human geography, and in the final part I shall analyse the economic features of the region.

F194.

# GEOLOGY OF THE JEBEL GARIAN



AFTER CHRISTIE



- |                |                                   |                        |
|----------------|-----------------------------------|------------------------|
| VOLCANIC ROCKS | EXTRUSIVE BASALT                  | CHICLA FORMATION       |
|                | INTRUSIVE PHONOLITE               | BU GHEILAN LIMESTONE   |
|                | INTRUSIVE BASALT                  | BU SHEBA GROUP         |
| CRETACEOUS     | GASR TIGRINNA FORMATION           | BIR EL GHNEM GROUP     |
|                | GARIAN LIMESTONE                  | AZIZIA FORMATION       |
|                | AIN TOBI LIMESTONE & YEFREN MARLS | FAULT DEFINED  ASSUMED |
| JURASSIC       |                                   |                        |
|                |                                   |                        |
|                |                                   |                        |

## CHAPTER I

### GEOLOGICAL BASIS.

The Jebel Garian was part of the vast Cretaceous anticline that extends from the Matnata area of Tunisia to the Tripolitanian coast of Homs. The northern limb of the anticline, which was formed of Triassic, Jurassic and Cretaceous rocks, was down-faulted in the late Cretaceous and was subsequently covered by Tertiary and Quaternary materials to form the Jefara.<sup>(1)</sup> The present day Jebel lies on the southern part of the anticline and has been modified by subsequent erosion so that the region may be divided into an incised broken northern rim and a southerly plateau called the Ghibla in Tripolitania and the Dahar in Tunisia.

Garian, however, occupies a geologically significant part of the escarpment. Firstly it lies in the area of orographic culmination so that the complete range of sedimentaries are exposed. Secondly, the area has been subjected to intense vulcanicity which is manifest in the intrusive basalt and phonolite and the large basaltic effusions of Bir el Uaar and Bir el Cur.

#### A. GEOLOGY. (See fig. 4).

The rocks found in the Jebel Garian thus belong to the Triassic, Cretaceous, Jurassic and to the volcanic activity which is of uncertain date (Table of Formations).

Table 1. TABLE OF FORMATIONS

Volcanic rocks, extrusives and intrusives: Basalt, phonolite.

CRETACEOUS	Cenomanian Euronian	Gasr Tigrinna formation 87M	Soft marls with lesser red and yellow limestone bands, white porous limestone, white limestone with chert interbeds.
	Cenomanian	Garian dolomitic limestone 55 M	Massive, white crystalline, in part silicious, colomitic limestone.
		Jefren marls	Soft yellow marls, clay, silt, and lesser limestone and gypsum.
	Ain Tobi limestone 79 M	Light coloured limestone, including the prominent, silicious, <u>Ichthyosarcolites</u> band.	
Wealden	Chicla formation 0-65 M	Red and white sandstone, small pebble conglomerate, and clay.	
Disconformity			
JURASSIC		Bu Gheilan limestone 0-55 M	Light coloured limestone, and dolomitic limestone, commonly brecciated and commonly colitic.
		Bu Sceba group 165 M	Sandstone, conglomerate, clay and minor gypsum. At or near the base is a 15 M thick band of brown marly limestone.
TRIASSIC	Muschelkalk	Azizia formation 110 M	Grey to dark grey to buff and pink compact limestones with some chert interbeds.
	Werfenian	Boutoniere formation 34 M	Fine-grained, dark red, micaceous sandstone, red and green silty claystone or clay, and lesser narrow carbonate bands.

Bir el Ghnem group  
100 M  
Gypsum with lesser limestone interbeds, minor sandstone, and red and green clay.

Table 2.

TABLE OF GEOLOGICAL HISTORY

ERA	SYSTEM	STAGE	DEPOSITS	NOTES
QUATERNARY	HOLOCENE	FLANDRIAN	Alluvial and Aeolian	Slight ingressión. Continental conditions for most of the Jefara.
	PLEISTOCENE	WÜRZ	Red calcareous crust with siliceous aeolian elements Sandy, reddish clayey material which is slightly ferruginous Marine sand	Mainly Continental
		RISS	Argillaceous and reddish sand.	Continental
		TYRRHENIAN	Almost continuous thin clay layer.	Marine
		HINDEL	?	?
TERTIARY	PLIOCENE	-	"Gefarico"	Continental, marine regression
	MIOCENE	PONTIAN	Sand and clay	?
		TORTONIAN	White and yellowish limestones	Marine
		HELVETIAN	Green and very fossiliferous clays and marls.	Marine
		LANGHIAN	Sand, sandstones, gravels and shingle.	Marine
	OLIGOCENE	-	"Gefarico"	Continental
	Eocene	-	"Gefarico"	Continental
MESOZOIC	MIDDLE CRETACEOUS	DANIAN		Retreating Sea
		SENONIAN	Marls, chalks, limestones and crystalline limestones.	Transgressive and oscillating movements of the sea. Doming of the Jefara and N.W.-S.E. faulting near Tarhuna.
		TURONIAN	Massive limestones (Nalut Limestone in the west). Soft marls with lesser yellow, red and white limestones (Tigrina formation in the east).	Marine
		CENOMANIAN	Tufaceous limestones, variegated marls and sandstones. (In the Gharian area Christie divides the deposits as follows: Gharian Dolomitic Limestone, Yefren Marls, and Ain Tobi Limestone)	Total immersion of land by the sea.
	LOWER CRETACEOUS	ALBIAN	Sandstones, quartz, conglomerates, cemented sands	Continental. Deposits thin and disappear to the east.
		WEALDEN	Marls and Clays	Continental. Deposits in the east more of a sandstone and conglomeritic nature. Albian and Wealden rocks form small cotes in the west.
	JURASSIC	BAJOCIAN	Bu Cheilan Dolomitic Limestone.	Marine and lagoon conditions.
		LIAS	Bu Sheba Sandstone & Conglomerates. Bir el Ghna Gypsum.	Deposits make up much of the El Menshar Hills.
	TRIASSIC	MUSCHELKALK	Grey to dark grey, buff compact limestone.	Marine. Outcrops evident at Azizio and Sidi Bu Argub.

After Archambault (4) planche 1  
 Brichant (6) p.8  
 Christie (9) p.6  
 Despois (16) p.16  
 Lipparini (21) pp.226, 227, 248 and 280

1. Triassic. The Triassic outcrops are restricted to the foot of the Jebel scarp and the Jefara. They appear, however, to dip under the Jurassic at the scarp so that it is presumed that the Triassic underlies the Jebel. However, the fact that it is found in the scarp indicates that there is some form of relationship between the Azizia formations and those near the Vertice station of Garian. This relationship is important from the point of view of evolution.<sup>(2)</sup> (See table 2.)

The total thickness of the Triassic deposits is 144 metres made up from the Werfenian or Boutoniere formations and the Muschelkalk or Azizia formation.

(a) Boutoniere formation. This is the oldest known formation in the Garian and is only exposed at four places in the Wadi Gan area. Each formation is associated with small dome-like structures. The total exposed thickness is 34 metres and the series is composed principally of dark red fine grained micaceous sandstones, red and green silty clays or claystones and lesser limestones.

The section in Fig. 5 shows that the Werfenian, between By Gheilan and Bu Gannusc, is horizontally bedded but, further north, the strata disappear under the Muschelkalk. This irregularity indicates that the strata have been affected by earth movements because there is no sign of unconformity between the Werfenian and the Muschelkalk.

(b) The Muschelkalk. The Muschelkalk, which is best exposed on the southern bank of the Wadi Sart Bu On, is composed of

yellow and pink or dolomitic limestone with some chert interbeds and has a total thickness of about 110 metres. The lower part is composed of about 45 metres of light grey, hard and compact limestone which contains numerous fossils. Overlying this band there is another band, 15 metres thick, composed of light grey limestone without chert. At the top there is a five metre band of marly sandstone. The Muschelkalk sinks eastward like the Werfenian.

2. The Jurassic. The Jurassic deposits outcrop along the Jebel scarp and are not extensively southwards. They are composed of sandstones, gypsums and limestones, the varying lithology being related to the conditions in which they were deposited. Although the strata are horizontal they tend to sink eastwards where they also change in lithology (Fig. 5). The following divisions are found in the Jurassic:-

(a) Bu Sceba Group. At the base there are a series of sandstones which Christie<sup>(3)</sup> called the Bu Sceba group. This is composed of cross-bedded red to brownish sandstones and small pebble conglomerates with some white limestone and considerable thicknesses of red and green clays, in part bentonitic, and a minor amount of gypsum. Near the base is a 5-15 metre thick band of brown marly limestone over which the clays and gypsum outcrop. This group is found along the scarp from Caf Tahscent to Neubat. Further south it can be traced from northwest of Garian town as far as Ras el Taphuna in the east. It disappears west of Garian town but re-appears near

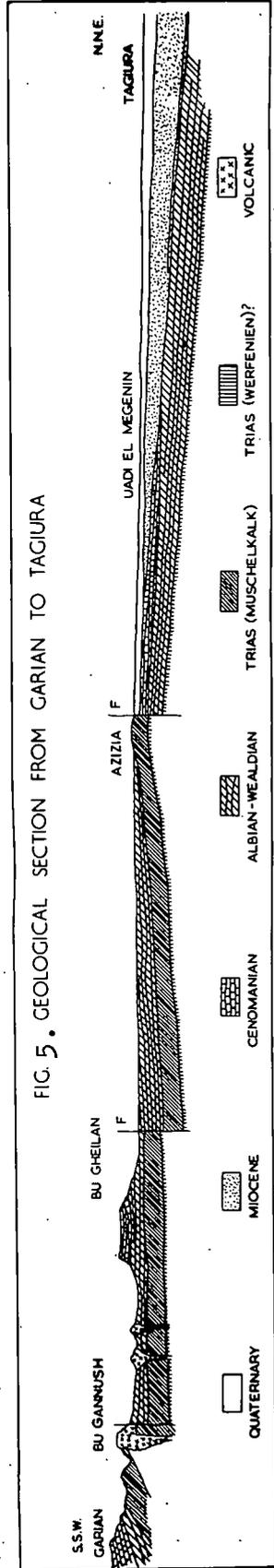


FIG. 5. GEOLOGICAL SECTION FROM GARIAN TO TAGIURA

Tadul. These variations in outcrop are related to unconformity.

(b) Bu Gheilan Limestone. The second group of the Jurassic, formed mainly of limestones, was called by Christie<sup>(4)</sup> the Bu Gheilan limestone. It is composed mainly of a light coloured white to buff to light grey to light brown limestones and dolomitic limestone. The lower 20 metres of a section at the highway near Bu Gheilan are much fractured and re-cemented to form a breccia. Above this, narrow layers of colitic limestone occur. At the top of the formation the carbonate rocks are interbedded with clay.

The Bu Gheilan limestone extends from Caf Tahscent to the southeast of Bu Gheilan as far as the Ras el Taphuna whilst it stretches south of Tahscent to Caf Tecut. The formation thins eastward gradually and this may be traced along the Jebel scarp.

The existence of brecciation and recementation in this formation indicates that earth movements occurred during its formation. This is also indicated by a small sharp fold bounded by two sealed fractures in this series near Bu Gheilan.

(c) Bir el Ghnem Series. The upper Jurassic was called the Bir el Ghnem series by Christie.<sup>(5)</sup> It is composed of white to grey gypsums with interbedded grey limestone. The series is about 100 metres thick and appears to be intercalated between the Bu Gheilan limestone and the Wealden Chiecla formation at Caf Tahscent.

The series is exposed between the Wadis Zaggut-Arbaa and

Crema being thickest near Bir el Ghnem but thinning eastwards and eventually disappearing.

3. The Cretaceous. The Cretaceous deposits are the most extensively exposed in the Jebel. They form the surface of the plateau and are the youngest rocks found in Garian. There is a distinct and immediate division between the continental Wealden deposits of the lower Cretaceous and the limestones of the Cenomanian and Cenomanian - Turonian. Christie divided the latter into: the Ain Tobi limestones, Jefren marls, Garian limestones and the Gasr Tigrinna beds.

(a) The Wealden: Chicla beds. The Chicla beds are composed of sand, sandstones, red and green clays, marls, black shale beds and some lignite. The total thickness is variable being 100 metres at Ain Tobi and 65 metres at Bu Gheilan. The formation thins eastward and is only 2 metres thick at Tadul whilst it disappears completely east of the Wadi Gan. It is of continental origin and the lignite indicates that it may have been derived from a lacustrine swamp. Christie<sup>(6)</sup> does not explain the alterations in the Wealden but suggests that the reason for the greater thickness in the east may be related to the outcrop of beds of Albian age. This would explain the lithological variations in the formation.

(b) The Ain Tobi Limestones (Cenomanian). The Ain Tobi limestones are composed of limestones of varying lithology which may be grouped into the following bands:-

(i) White to buff marly limestone of chalky appearance. It

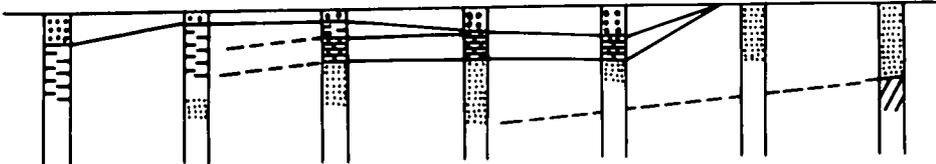
Fig. 6.

CROSS SECTION ALONG JEBELFRONT SHOWING  
LATERAL VARIATION IN FORMATION BELOW

AIN TOBI AFTER A. M. CHRISTIE

RAS EL TAHUNA CAF MONTOUS EL BEDA CAF TAHSCENT WEST OF TADUL BU GHEILAN RAS EL TAHUNA EN NEUBAT

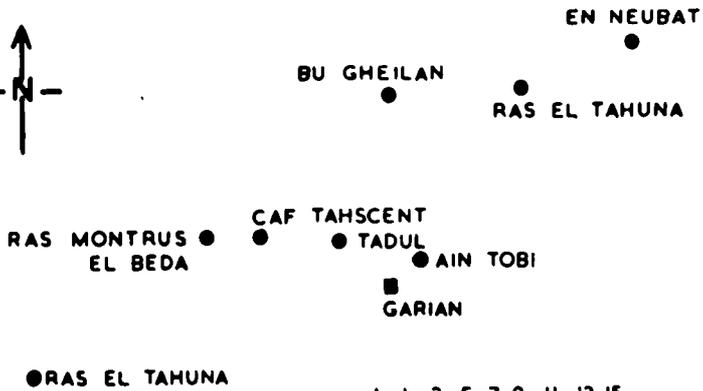
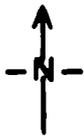
BASE OF AIN TOBBI LIMESTONE



-  CHICLA FORMATION
-  BIR EL GHNEM GROUP
-  BU GHEILAN LIMESTONE
-  BU SCEBA GROUP
-  AZIZIA FORMATION



LOCATIONS



is commonly porous with a minor amount of argillaceous material. This band, which is 14-20 metres thick, is interbedded with narrow sandy strata.

(ii) Group similar to the above but with more argillaceous material.

(iii) Hard massive limestone that is one of the most conspicuous stratum in Garian. It consists of an upper band of "reef limestone" formed by fragments of the rudistid *Ichthyosarcolites* and other organic remains. It is about 5 metres thick.

(iv) White to buff marly limestone with rare nodules of chert and narrow argillaceous interbeds.

The total thickness of the formation is 69 metres. It covers an extensive area from the Wadi Gheddaf on the east, and extends over much of Orban and Guasem.

(c) The Jefren marls (Cenomanian). These horizontally deposited strata overlie the Ain Tobi limestones with conformity and are about 80 metres thick. Typical sections are hard to trace because the formations are composed of soft and easily eroded strata.<sup>(7)</sup> The main constituents are soft yellow marls, clays, silts and lesser limestone and a 2 metre band of almost pure gypsum is found in most exposures. It is widely distributed, however, though its lithological nature means that it cannot be separated from the Ain Tobi series. Thus, they have been mapped as one unit (Fig. 6 ).

(d) Garian limestone. The Garian limestone is extensively exposed and forms the upper part of the Cenomanian. It is

composed of massive white crystalline limestone which is also dolomitic and partially cherty. The total thickness near Bu Ayyad is 55 metres, the lower 20 metres of which are composed of dolomitic limestone whilst the upper 27 metres are composed of well bedded white limestone of massive structure. The Garian limestone is of great importance since its hard massive structure means that it is highly resistant to erosion. The Garian limestone is found along the Jebel scarp east of Garian but it is most extensively exposed between Garian town and the great basalt effusives of Bir el Uaar.

(e) Gasr Tigrinna formations. Owing to the occurrence of fossils of both Cenomanian and Turonian age in these strata, Chiesa<sup>(8)</sup> has assigned them to the Cenomanian-Turonian. It is composed mainly of soft marls with lesser limestones, red and yellow limestone bands and some clays. The total thickness of the formation is 87 metres. There is a lower band composed of 38 metres of marl, clay and red or yellow limestone. Above this, there is found a porous white chalky limestone interbedded in places with a few narrow layers of soft marl and clay.

The Gasr Tigrinna formations extend from the vicinity of Tigrinna village southwards to the Wadi Gan (see Fig. 4 ). The formations underlie the fertile soils of Asabaa and Tigrinna.

4. Volcanic rocks. Volcanic rocks are found in many parts of the Jebel Garian but the main exposures are concentrated in the southwest towards the Tarhuna and Mizda borders. They occur as dykes, larger intrusions and effusions. Christie divided the

volcanic rocks into three groups, intrusive phonolite, intrusive basalt and extrusive basalt.

(a) Intrusive phonolite. The phonolite is much more acidic than the basalt being less dense and lighter in colour. It has the appearance of either andesite or trachyte. These rocks are commonly sheared and foliated parallel to the walls of the intrusion indicating that they were deposited as a viscous mass.

(b) Intrusive basalt. These rocks are very basic with abundant olivine and small crystals of pyroxene and laths of plagioclase feldspar.

(c) Extrusive basalt. The extrusive basalt rocks are very thick and are poorly exposed. They thin rapidly outwards so that the edges of the main basalt masses are only 5-10 metres thick. As the basalt occurs at a much lower level in the Wadis Gheddaf and Gan than in the main masses, it is assumed that the basalt flowed down these wadis. Therefore, they must post-date these features, and be very young geologically speaking. The fact that they rest on a crust or hardpan in the wadi bed indicates that they may be of late Pliocene or Quaternary age. Some, however, may be older.

6. Structure. Little is known of the Triassic rocks but the beds appear to be fairly uniform in composition and thickness. The Jurassic and Cretaceous rocks show lateral variation in composition and thickness and in general thin to the east and thicken to the west. On top of these, the Cenomanian and Turonian formations appear to be of constant character and thickness, <sup>(9)</sup> and have

been horizontally deposited.

Two types of volcanic rocks are found: a large mass of basalt in the southeast and a series of phonolitic intrusions that appear to be roughly aligned in a northwesterly direction. It is possible that the two types of volcanic rocks may be genetically related.

Several dome-like structures were noted in the area. There is one just north of Garian and another two in the Wadi Gan. It is possible that these are related to the injection of unexposed igneous bodies.

Certain other broad structural features probably exist but further exploration is necessary to prove them. Thus, the Garian limestone descends from elevations high in the Jebel to the level of the Jefara at el Ghedea. This appears to be related to a major northwestward trend in flexure or fault evident near the boundary of the map area (Fig. 4 ).

Several small faults may be traced, the largest of these trends northwestward near the two small domes just east of the Wadi Gan. The maximum apparent displacement along this fault is over 200 metres near the more southeasterly small dome.<sup>(10)</sup>

#### C. Summary and Conclusions.

The Jebel Garian is formed by a thick series of strata dating from the middle Triassic to the upper Cretaceous. The lithological variation is expressed in the alternating series of sandstones, limestones, marls, clays, silts and sand. The Cenomanian beds are the most prominent and are horizontally

deposited, the whole overlying the Wealden and Jurassic with unconformity.

The structure is relatively simple but has been altered by northwest-southeast faulting and by volcanic infusions and effusions.

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## CHAPTER II

### CLIMATE

The Jebel Garian has climatic conditions not unlike those of the rest of northern Tripolitania. The only real differences are due to its central position in the Tripolitania escarpment and its altitude. The Jebel Garian is much higher than the neighbouring massifs of the Jebels Nefusa and Tarhuna; the highest elevation in Garian is 872 m. above sea level compared with 713 m. at Yefren and 430 m. in Tarhuna. Position, orientation and height bring modifications to steppe conditions and make the Jebel a climatically favoured zone in which Mediterranean characteristics reassert themselves.

In fact, the Jebel has a climate intermediate between those of the steppe and maritime. Fig. 7 shows the climatic zones which were adopted by Fantoli in 1952.<sup>(1)</sup>

Mean maximum temperatures are lower than the steppe because of the height; on the other hand mean minimum temperatures of 5°C are experienced in the higher parts of the Jebel. The annual trend of humidity comes between those of the maritime and steppe. However variations in the humidity when the wind shifts between the two most typical winds N.W. and S.E. are much less than on the maritime.

The annual precipitation is generally lower than on the maritime but rises to more than 300 mms. in restricted areas in the Jebel with a marked decline towards the Tunisian border

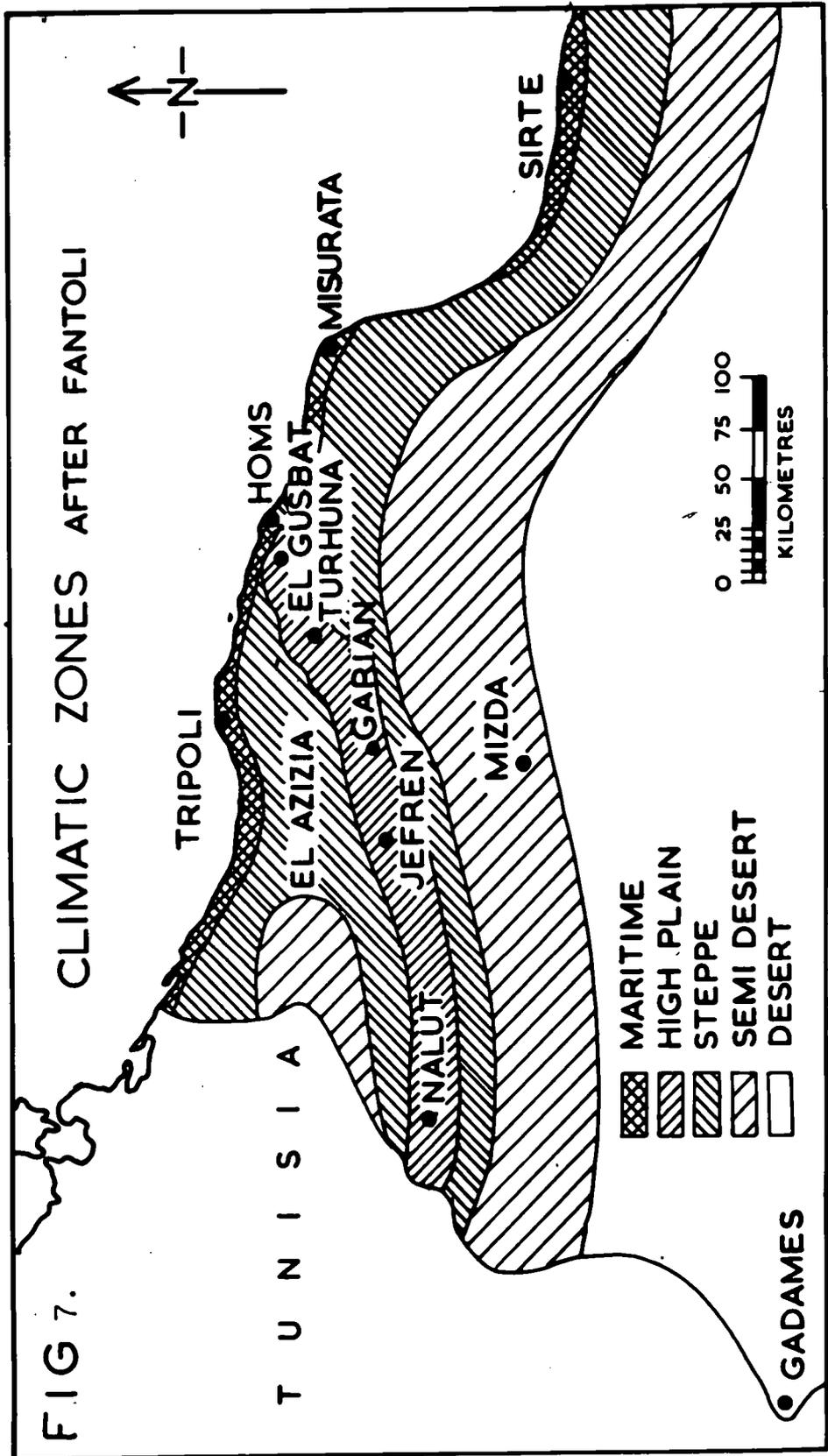
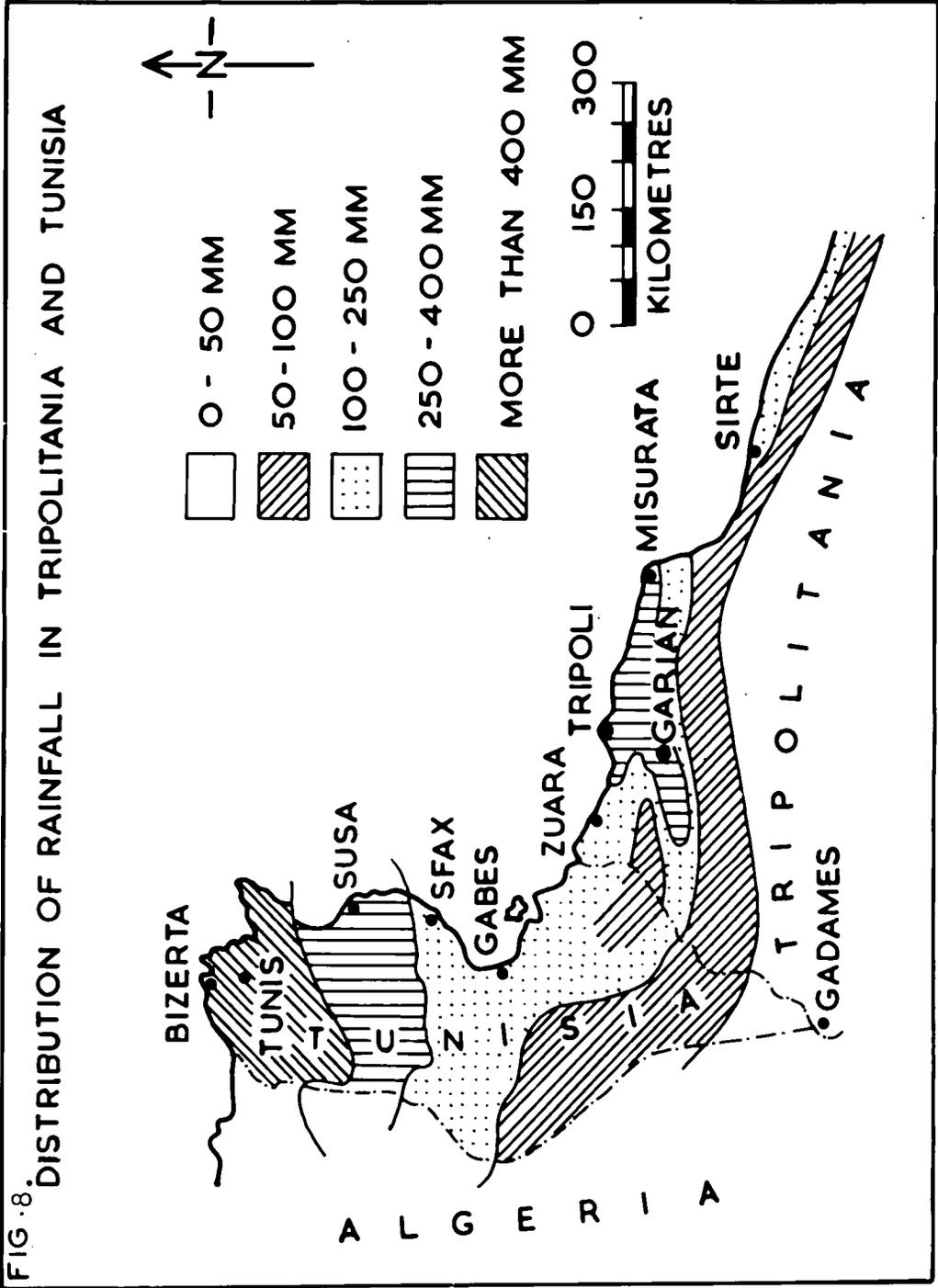


FIG 7.

as the distance from the sea increases and the orientation changes. Fig. 8 shows the distribution of rainfall in Tripolitania and Tunisia.

Much of the western part of the Jebel and the area succeeding the steppe and southern zone of Garian are semi-desert (Fig. 14). Maximum temperatures in summer are lower than the steppe because of the increased altitude. On the other hand, there is intensive heat/during the night in summer by the drop in the temperatures below zero. Relative humidity is usually low though variable, depending on the change of winds which are prevalently north-east. Beyond the remote southern zone of the Jebel the climate becomes definitely semi-desert and Saharan.

The Jebel Garian is influenced by both maritime and Saharan climatic regimes. The former appears in the upper regions of the Jebel and the latter is represented in the lower parts of the mountain.<sup>(2)</sup> Furthermore, between the two types of climate, another type is found in the intermediate zones of the Jebel. In other words, altitude generally modifies the climatic factors which prevail throughout Tripolitania, namely the Mediterranean and desert climates. The existence of two more or less hostile influences necessarily leads to a permanently unstable situation which is reflected in the climatic characteristics of the country. The latter are the result of considerable and frequent variations rather than the expression of a relatively stabilised environment. Consequently, the usual terminology is not sufficient to describe



the situation with the accuracy and completeness required to give an adequate estimate of the effects of this instability, particularly in the realm of biology where it finds fullest and most obvious expression.

A short examination must suffice to show the major meteorological elements affecting the climate in the Jebel. Maritime influences from the north-west are confined mainly to the winter months when the southwards migration of the main world atmospheric belts takes place. The Saharan itself is governed by the horse latitude high, a dominion which spreads to include virtually the whole Mediterranean littoral in summer. Intersition between the western maritime influences of the Mediterranean and the Saharan high pressure system is the fundamental factor behind the climate conditions experienced throughout Tripolitania.

In winter (October-March) the Mediterranean regions are an area of low pressure between the semi-permanent Azores anti-cyclone and the continental pressure of Eastern Europe and Asia. (3) Air is drawn into the region from widely separate areas. Polar air from Europe and the North Atlantic and Tropical air from the Sahara. Temperature contrasts are marked between the Tropical and Polar air masses and fronts often exist in the western Mediterranean and subsequently move eastwards. However northern Tripolitania in general and the Jebel Garian in particular lie to the south of the main tracks of these depressions, and are consequently affected mainly by rainfall which is

somewhat unreliable in distribution and amount. Between, unsettled conditions associated with the various spells of fine weather are common.

In summer (April-September) the circulation of air masses is less active, for the region lies on the eastern border of the semi-permanent Azores anticyclone. The mean pressure over central Asia is low at this season and north or north-west winds are prevalent over the Mediterranean. But the contrasts between the Polar and Tropical air masses are far less than in winter. Settled conditions and constant wind directions are usual. However when the relatively high pressure over Cyrenaica is intensified by southerly winds, temperatures result in the exposed and low lying areas of northern Tripolitania.

Autumn and Spring are brief periods of transition when weather conditions of either summer or winter may occur.

These weather conditions which recur in a similar pattern each year are responsible for the outstanding seasonal features of the Mediterranean type of climate; mild moist winters and hot dry summers with a relatively uniform annual temperature sequence. In the whole of the Jebel this seasonal rhythm applies only in a very general way since:-

- (a) The position of the Jebel in the southern Mediterranean and its extension southwards mean that it is marginal to the cyclonic activity.
- (b) The situation of the region in the lee of Tunisia and the

high Atlas shelters much of the area except for the coastal fringe and the seaward facing edge of the Jebel from the main bearing north-westerly winds.

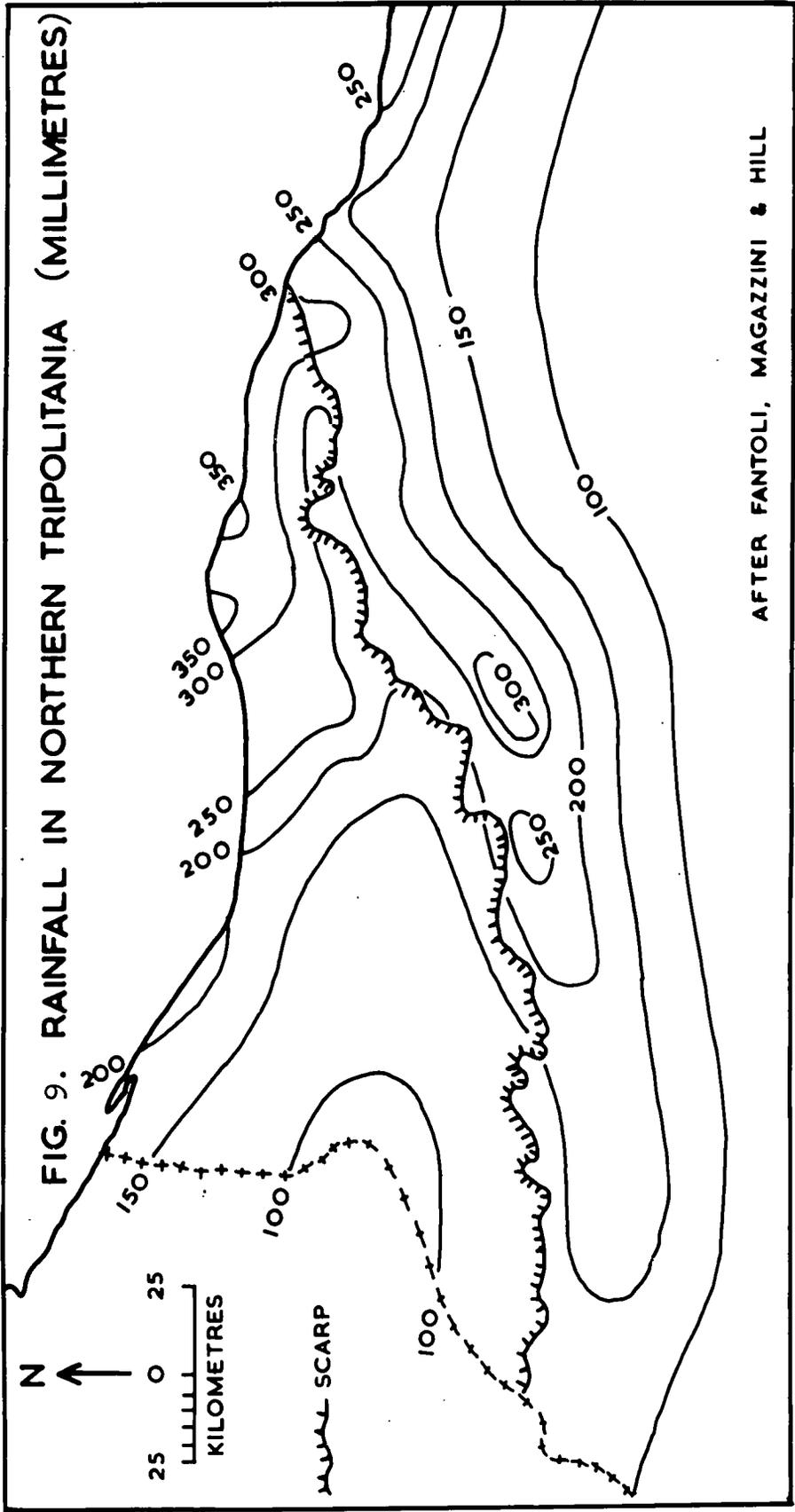
- (c) Tropical air has relatively free access from the Sahara to the coast. Summer temperatures tend to be accentuated and the period of summer drought is normally extended from April to September in contrast to areas in the northern Mediterranean where the summer drought period is usually not more than three months.

### RAINFALL

Most of the rainfall of the Jebel occurs in autumn, winter and spring, and accompanies the depressions crossing the region from the Mediterranean.

Garian meteorological station kept continuous records for 26 years and the average yearly precipitation was 326 mm. (4)  
The average is high compared with Yefren and Tarhuna where the mean annual rainfall is 260 mm. and 263 mm. respectively. The reason is the height of the Jebel Garian. Fig. 9 shows the distribution of rainfall zones of Tripolitania and it seems that obviously the Jebel Garian is the only region which catches more rainfall after Tripoli City and maritime zone.

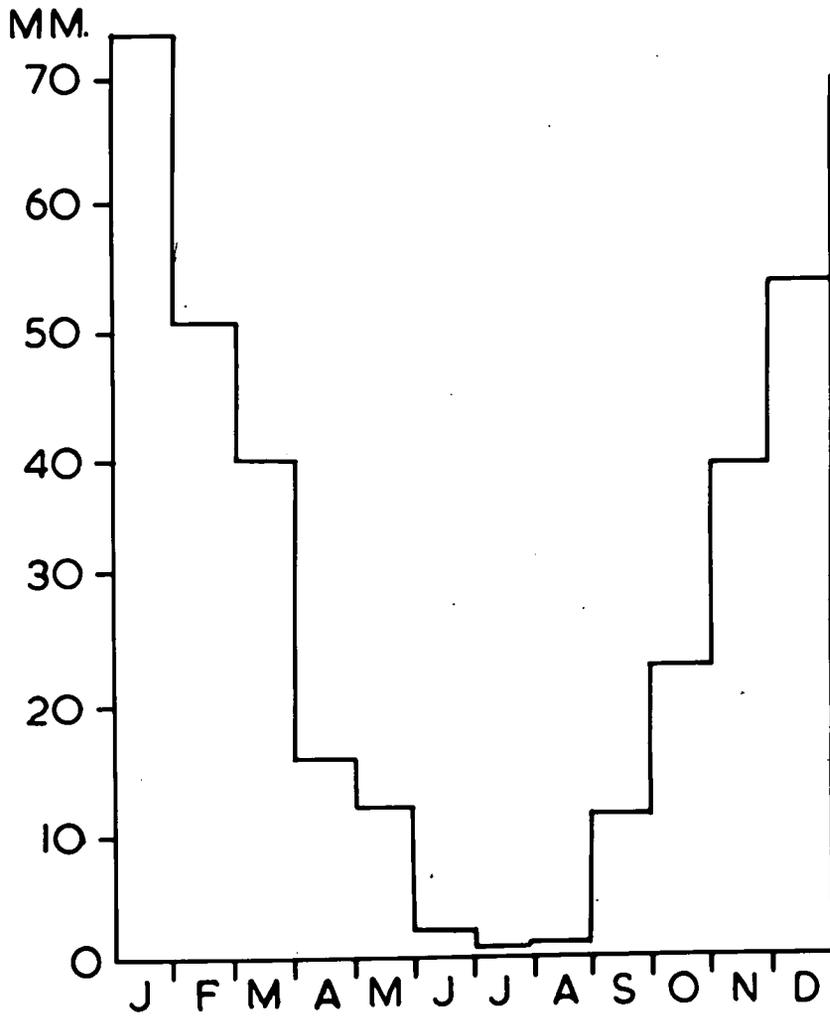
The annual number of rainy days in Garian ranges from 40 and 50 and rainfall is heaviest in December, January and February.



AFTER FANTOLI, MAGAZZINI & HILL

FIG. 10.

MEAN MONTHLY RAINFALL : GARIAN



Mean Monthly Rainfall, Garian (1914-1956) <sup>(5)</sup>

J	F	M	A	M	J	J	A	S	O	N	D	Year	Per- iod
74.1	51.5	39.9	16.0	12.7	2.1	0.5	0.7	11.4	23.8	39.8	54.0	326	32

This table illustrates that rainfall is mainly concentrated during winter and that there is more in the autumn months than in the spring. During the summer, rainfall is slight but summer in Libya is characterised by aridity. (Fig. 10)

Garian station started recording rainfall in 1914, but they ceased in 1915 until 1923. From 1924 to the present day there have been continuous recordings except in the war years of 1941 and 1942. Table 1 <sup>(1)</sup> shows the records for precipitation from 1924 to 1949. In addition, there are another three meteorological stations; Tigrinna (1934-49), Bu Maad (1934-42), Asabaa (1941-49) <sup>(6)</sup> Those stations are situated in the agricultural zone of the Jebel, and they indicate considerable annual oscillations in total rainfall as well as the periodicity of droughts due to climate conditions explained above. There is in fact very slight difference in precipitation between Garian and the other stations. This may be due to the fact that Tigrinna, Bu Maad and Asabaa have not started recording at the same date and they have different recording periods. Thus the Garian Station will be taken as an example and guide for distribution and frequency of rainfall in the Jebel Garian owing to the fact

(1) See Appendix I.

that this station started recording earlier than the other stations.

### Monthly Periodicity

In terms of mean monthly rainfall the regime is seen to consist of a rapid increase in September to maximum in December, January and February, when there is gradual decline until May. June, July and August are virtually rainless. This rainfall regime differs from those of stations north and south of Garian as the following data indicates:-

#### Distribution of winter rainfall in Percentages in Garian and other towns

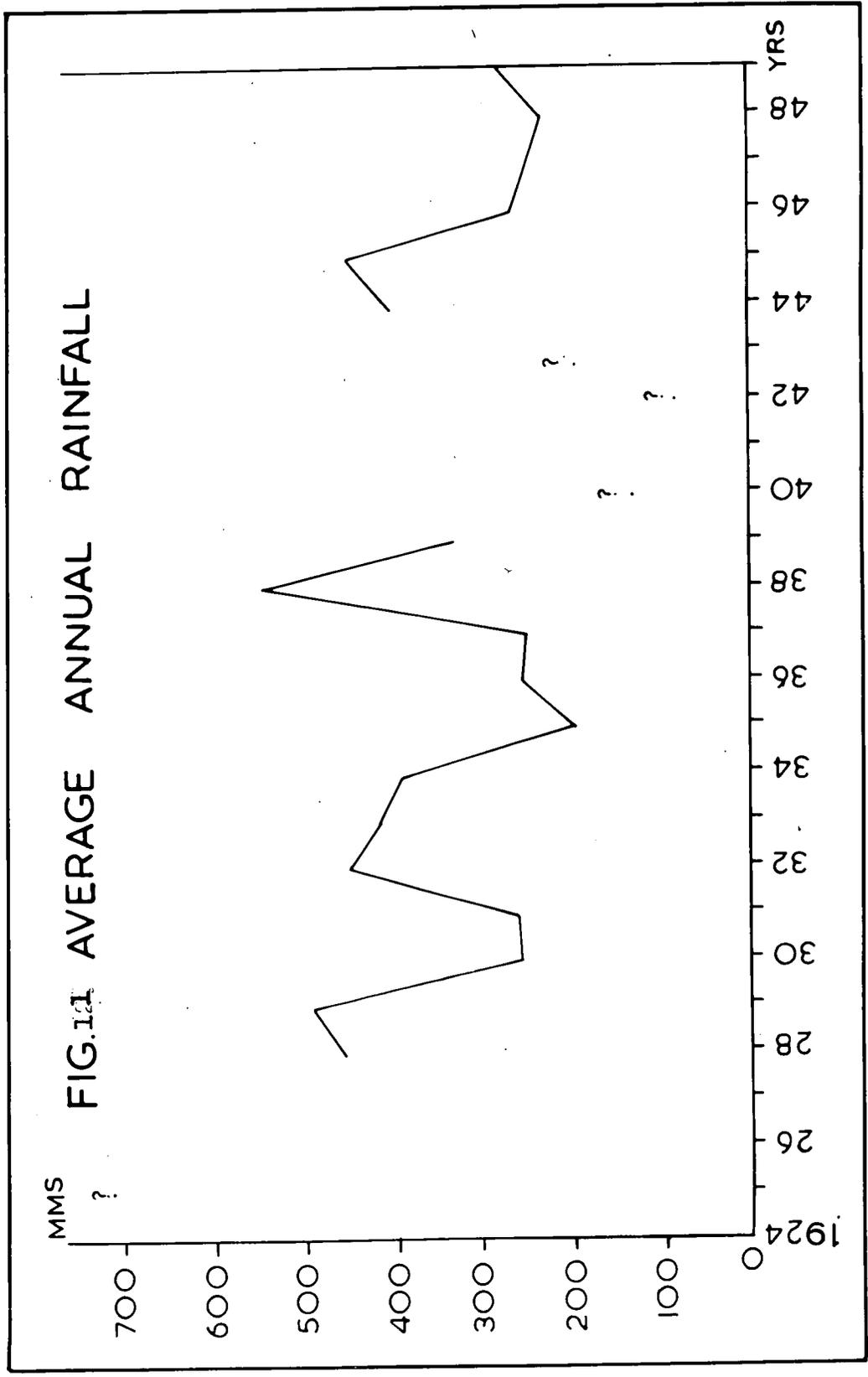
	<u>Oct.-Nov.</u>	<u>Dec.-Jan.</u>	<u>Feb.-March</u>
Tripoli	30	50	20
Azizia	22	50	28
<u>Garian</u>	22.4	45.3	32.3
Beni Ulid	28.4	35.4	36.2

It is obvious that the greatest concentration occurs in mid-winter and that autumn and early winter rains are usually less than those of late winter and early spring. However, it will also be seen that Garian experiences a more even distribution than the two stations or the Jefara, but a less even one than Beni Ulid or the Ghibla.

#### Mean annual rainfall (Fig. 14 and Appendix I, table 1).

Garian's mean annual rainfall of 326 mms. (32 years) is a composition of figures ranging between 547 mms. in 1938 and 151.8 mms. in 1947 and annual precipitations show wide deviations from the mean.

FIG. 1.1 AVERAGE ANNUAL RAINFALL



A good year is often succeeded by a poor year. The extremes are falls of 150-250 mms. which can be disastrous to crops. Drought may, however, be local and affect only one small area. Every year there is localised drought; generalised drought is more periodic.

Rain-days.

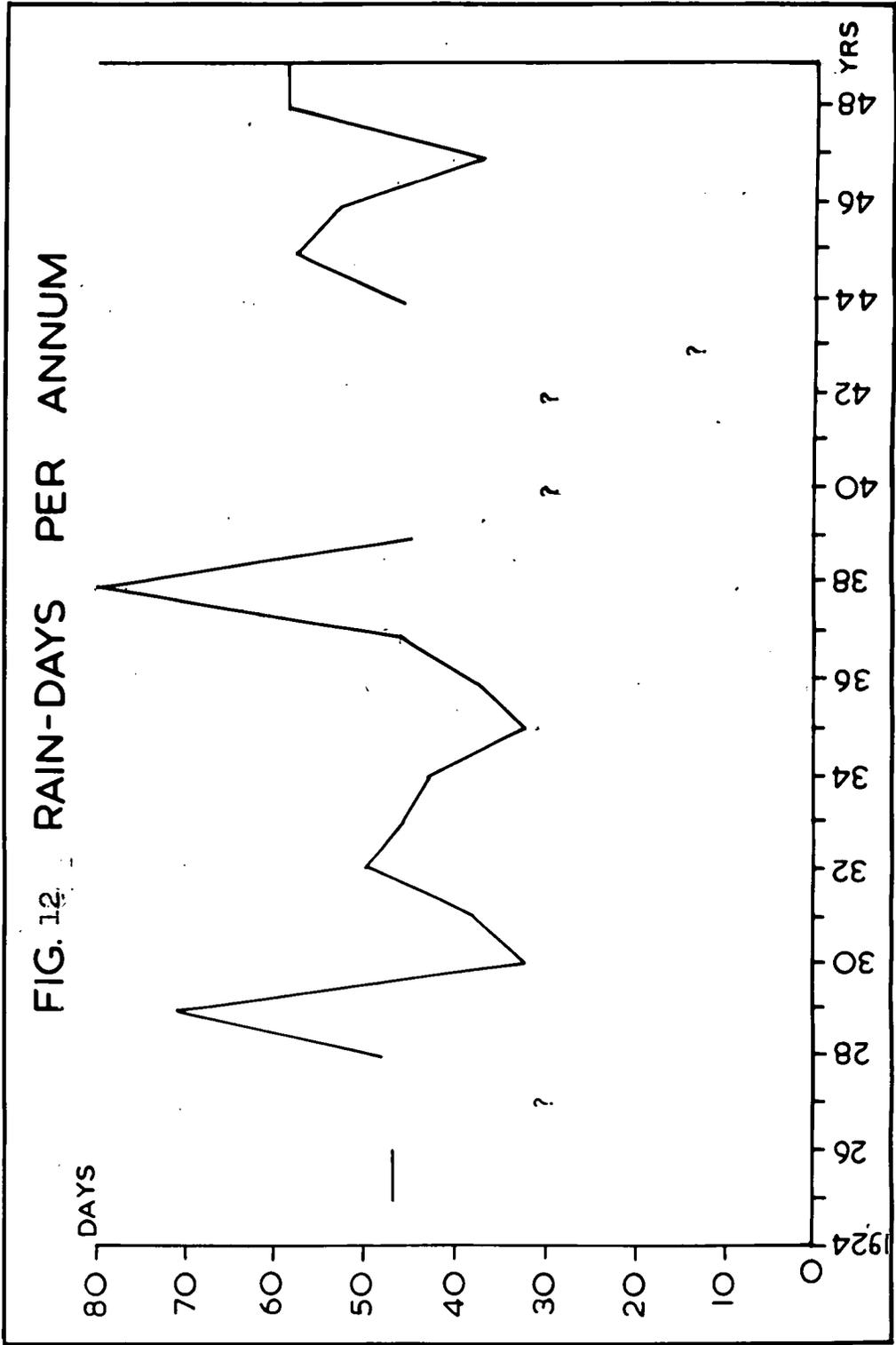
The same characteristic regime is apparent in the monthly distribution of rainy days. Although the term rainy day is a useful analytical concept, its quantitative implications are rather uncertain since the amount of rain falling in that period is extremely variable. A rain-day is of course defined as which the minimum rainfall recorded is 0.01 mms.<sup>(7)</sup> The rainfall records for the 32 year period have been examined for the frequency of rain-days yielding certain critical amounts of rain.

It is apparent that the monthly frequency of rain-days follows closely the pattern of rainfall with the largest numbers of rain-days in the three winter months of December, January and February and less in late winter and early spring than in autumn and early winter.

Frequency of rain-days in the month periods.

<u>Dec.-Feb.</u>	<u>Mar.-May</u>	<u>June-Aug.</u>	<u>Sept.-Nov.</u>
47.7	24.1	2.5	25.7

The average frequency of rain-days in a 26 year period is 44; but in a good year 80 (1938) days are rainy, whilst in a bad year



only 16 (1941) may occur. The highest number of rain-days usually coincide with the highest amounts of rainfall, and vice versa, but this is not necessarily so. (Fig. 12).

Some years of Rainfall.

(1) Low rainfall years.

Year	J	F	M	A	M	J	J	A	S	O	N	D	Total
1935	48.8	15.5	71.6	0.1	0.9	0.0	0.0	4.3	29.1	5.7	18.8	2.2	197.0
1941	0.0	12.4	20.9	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	28.4	63.5
1947	24.3	3.8	18.2	13.3	2.0	0.0	0.0	0.0	3.0	4.5	60.0	22.7	151.8

(2) Average Rainfall years.

Year	J	F	M	A	M	J	J	A	S	O	N	D	Total
1930	28.8	43.5	33.8	24.0	11.6	0.0	0.0	0.0	0.0	35.3	35.8	43.6	256.6
1939	81.3	74.3	28.9	51.1	16.2	0.2	0.0	0.1	29.4	0.8	23.1	30.4	335.8
1949	39.1	40.7	65.4	24.2	1.5	1.3	0.0	8.9	0.0	54.5	12.9	25.5	274.0

(3) High rainfall years.

Year	J	F	M	A	M	J	J	A	S	O	N	D	Total
1926	175.8	132.5	65.1	56.8	0.4	15.2	0.0	10.4	7.9	0.1	9.4	44.2	510.0
1932	183.3	33.6	61.0	0.0	0.0	0.0	0.0	0.0	18.2	57.8	91.1	57.9	502.9
1938	133.4	80.3	100.9	49.2	21.7	0.2	0.0	3.3	0.2	8.3	69.2	81.2	547.9

(1) It has been shown that January, February and March are three rainy months. But in 1941, for example, there was significant failure in the rains of January and February.

(2) During the 26 years recorded in Garian Station the only year average rainfall with more or less was 1939. This year had an average of 335 mms. with a maximum in January.

(3) The only exceptionally wet year recorded was in 1938 when December, January, February and March were wet months.

### Storm Rainfall.

The main rainfall of the Jebel is convectional precipitation resulting from air currents rising in turbulent air masses, the turbulence being caused by heating or by the contact of air masses of different temperatures. The overheating of land and resultant instability is especially a feature of the early months of the rainy season and more particularly in October whilst the contrasting temperatures of different air masses is closely associated with the passage of depression over the Jebel Garian. These follow three main tracks:- (8)

1. Depressions which pass to the north of the Eastern Mediterranean  
These depressions mainly form in the Western Mediterranean or over North-West Africa. They may originate as lee depressions when a northerly current of cold air reaches the Alps or may appear as "wave depressions" on an east-west front over north-west Africa or the south-west Mediterranean. In either case the warm front, if it exists, does not affect the air route over the escarpment. The cold front can usually be traced south to the North African coast and may cause showers on the Jebel Garian. Otherwise fine weather continues over the Jebel during the passage

of depressions on this track, which is common at all seasons, and is followed almost exclusively in summer by such depressions as approach the region.

(2) Depressions which move east to the region of Cyprus.

These depressions form in the same way as those which pass to the north. They most frequently follow this track through the Eastern Mediterranean in winter and spring, in which seasons it is the predominant track for depressions in the region. At other seasons depressions passing to the north are more common.

The warm fronts of these depressions, if they exist, rarely affect the air route; only about once or twice a year are thick warm-front cloud masses encountered. The cold fronts, however, moving south and east affect the whole Jebel Garian in particular and Tripolitania in general. They usually cause showers or short periods of rain. It is rare for solid cloud masses to extend above 15,000 ft. either in connection with fronts or convection in polar masses. The rainfall and extent of cloud masses associated with these depressions decrease with remarkable rapidity/as one passes inland.

(3) Khamasin or Ghibli depressions. These depressions form over the desert of North Africa as wave depressions on fronts separating air masses which have been over Africa for some time and have been considerably warmed, from polar air which has recently crossed the Mediterranean and is much cooler. As the warm air mass is very dry the cloud associated with these depressions

is not extensive. The warm front, if it can be traced, is diffuse, but the cold front is usually clearly defined.

The depressions which affect the Jebel often form south of the Gulf of Sidra, but they may form much further west, indeed the origin of some of the depressions, which are of importance over Tripoli, can be traced back to the passage of a cold front over the Atlas Mountains. Depressions forming well to the west frequently turn north over Tunisia and pass on over Italy and the Adriatic. Ghibli depressions which first appear over Libya usually move eastwards; sometimes they cross the Libyan coast and move out over the Mediterranean. They are preceded by strong southerly winds which cause widespread sandstorms as well as high temperatures. The passage of the cold front is marked by a rapid change of wind to north-westerly. In some cases the north-west wind is sufficiently strong to maintain rising sand for a while. Once the cold front has passed the increase in relative humidity of the north-westerly air stream causes the formation of the cumulus or curmulonimbus clouds and showers may occur on the Jebel. The cloud is seldom low enough to be a hazard to flying. Subsidence in the cooler air is fairly rapid and broken strato-cumulus cloud is common in the morning immediately following the passage of a cold front of this type.

Although the convectional element is largely responsible for the rainfall, it seems clear that the effects of the Jebel rising suddenly from the plains at some distance from the coastal zone

of Tripolitania, to heights of 850 m. is significant only in the sense that the resultant lifting of the air mass may occasionally trigger off precipitation in already unstable air. In summer the excessive heating of the air immediately above a light coloured surface will encourage instability and the development of incipient thunderstorms.

However, it is difficult to assign precise limits to what should be considered as storm rainfall, and therefore statistical analysis is difficult. We know that the intensity of rainfall increases inland from the coast and that 20 mms. falling within a 24 hour period causes significant damage. Given the convectional nature of the rainfall, it is unlikely that a daily reading of 40 mms. results from anything than storm phenomena.

The data for rainfall intensity is scanty and one can only repeat the observations made by Fantoli (9). In Azizia in 1078 observations between 1919-49, rainfall over 20 mms. constituted only 5% of the total and rainfall over 40 mms. only 0.7%. On the other hand in the Jebel Garian falls of 20 mms. comprised 21% of the total and rainfall over 40 mms. formed 70% of the total observation taken between the years 1924-49.

The two major centres in northern Tripolitania for storm rainfall appear to be Tripoli and the environs of Garian separated by an area of less intensive rainfall on the Jefara. In terms of rain-days relative to total rainfall the greatest intensity of rainfall would appear to be in the Jebel.

The effects of such storms are difficult to assess over a large area. They are generally responsible for filling field cisterns, whilst the rapid surface flow of the wadis clears the soil of debris accumulated in the wadis so that they function to better effect later in the year, but these benefits are extremely local and great difficulties are often experienced in the lower parts of the wadis where much of the mud, stones and rubble accumulates. The intense rainfall means that the calcareous elements and the soil nutrient are washed down the soil profile. In restricted places of the flood waters bring about a redistribution of soil resources so that the lowlands benefit from a renewed soil cover; but the uplands obviously suffer from soil erosion (Plate 1).

When the rains fall heavily damage can be caused in several ways; damage to the crops by direct impact, damage by underground seepage which affects deep rooted plants, and damage by run-off which affects dams, walls and roads.

However, there is much variation of precipitation from place to place. This may be due to the fact that the frequency of heavy storms is higher in some zones than in others. In general, most storms come from the north-west, and much are convectional but the sudden uplift of the Jebel front is sufficient to increase the precipitation from a cloud and to stimulate rainfall in one that is becoming stable.

#### Distribution of dry and wet years.

In wet years, the isohyets move southwards so that the

Ghibla has a much higher rainfall than normal. In drought years (1947-48), the isohyets move northwards so that Garian can have a rainfall of less than 200 mms. which will mean that there will probably be no cereal harvest and only a small olive crop.

In 1947-48, the 200 mms. isohyets in Tunisia moved northward to affect the best farming areas and major zones of olive cultivation. In this same year, Garian had no cereal crop whilst the eastern Jefara had only a fair crop. The result was expressed in massive imports of wheat and barley from abroad.

From Table (1)<sup>(1)</sup> it can be seen that a dry year appears to occur every 4-5 years. There is insufficient data fully to illustrate this recurrence through the use of "running means" but some idea of the fluctuation is provided by the table.

#### Other Forms of Precipitation.

Snow is very uncommon but has occurred, as in February 1949, when one metre fell in three days and covered most of the Jebel. It is indicative of the low winter temperatures which can occur in the mountains.

Hail occurs more frequently and is usually of small size doing little damage. Occasionally, there are falls of hail stones of considerable size as in 1955 when they killed animals and destroyed agriculture produce.

Dew. The contribution of dew to the total moisture is frequently overlooked in arid regions such as the Jebel. Although dew is

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(1) See Appendix I

not easily measurable over the dry season, it is not unappreciable and probably contributes a significant quota to the available moisture for crops and vegetation.

HUMIDITY

The Jebel has low average humidity (Fig. 13) compared with Tripoli, Yefren, Tarhuna, Beni Ulid, Azizia and Mizda. The annual mean is 43%. In the winter months, the average mean is less than 56%. This low humidity is due to the fact that during this period of the year the Jebel is influenced by dry westerly winds blowing from the arid south of Libya.

Mean Relative Humidity (Garian Station).

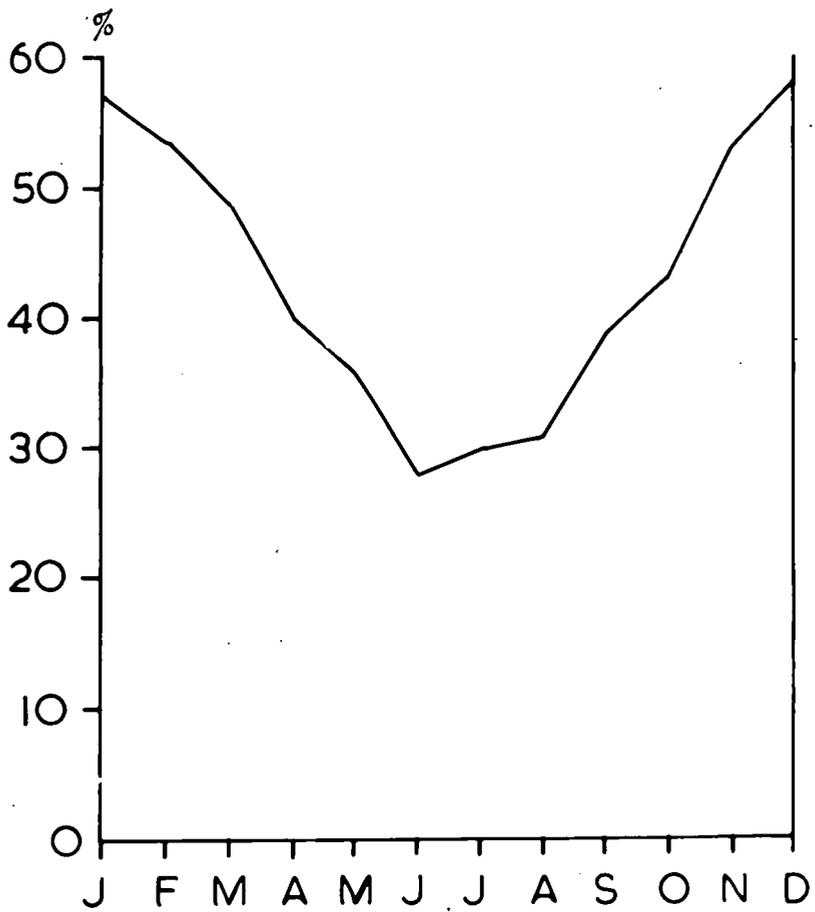
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J	F	M	A	M	J	J	A	S	O	N	D	Year	Period
57	54	48	40	36	28	30	31	39	43	53	58	43	27

---

Summer conditions present rather a different situation for the mean average is then 30%, lower than the other places mentioned above. For example, Tripoli has an average as high as 66% for the summer months, and even Mizda has an average of about 32% in spite of the fact that it lies to the south of the Jebel. This low relative humidity of the Jebel is due to the remoteness of the region from the sea and the high altitude of the area compared with the other places in Tripolitania. Thus the Jebel as a whole is favourable for growing olive, tobacco and some other fruit trees which require little humidity.

FIG.13. MEAN RELATIVE HUMIDITY :  
GARIAN (27 YEARS)



## EVAPORATION

The meteorological factor of evaporation together with the more hydrological considerations of run off percolation and sub-surface drainage and soil moisture conditions, enter into the whole problem of water availability for crop requirements (potential evapotranspiration). Unfortunately measurements of evaporation are totally lacking and the meteorological data is insufficiently detailed to allow the computation from empirical formula such as those of Thornthwaite of the rates of evaporation and the availability of moisture, but it is necessary to make brief observations on evaporation and evapo-transpiration.

Water is lost to the atmosphere in two ways; direct evaporation from water surfaces, e.g. pools in the Gattis land after rains, irrigation storage tanks (in specific areas of the Jebel), canals; and evapo-transpiration from the plant cover. Whenever the moisture is available, rates of evapo-transpiration are high especially in the late spring when water in the soil is at field capacity and temperatures are increasing. Work on potential evapo-transpiration has been carried out in several parts of the world but the nearest and perhaps the most relevant to this study, is that of Mitchell (10)(who has taken measurements at Hal Far in Malta which is situated only 200 miles north of Tripoli and conditions are only little more humid and cooler than those on the Jebel). Furthermore Mitchell claims a slight over-reading for his station. His figure, which can be considered minimal

when applied to Garian.

Potential Evapo-transpiration at Hal Far (Malta) and rainfall at Garian Station.

<u>Month</u>	<u>Potential evapo-transpiration Hal Far</u>	<u>Rainfall, Garian Station.</u>
September	172.7	11.4
October	121.9	23.8
November	137.2	39.5
December	78.7	54.0
January	63.5	74.1
February	76.2	51.5
March	83.8	39.9
April	99.1	16.0
May	160.0	12.7
June	165.1	2.1
July	177.8	0.5
August	<u>210.0</u>	<u>0.7</u>
Year	<u>1,546.9</u>	<u>326.2</u>

The relationship between these two sets of figures shows that in two months only, the monthly rainfall amounts at Garian Station exceed potential evapo-transpiration. A moisture surplus is built up in the soil during these months, but for most of the remainder of the year there is moisture deficit.(11).

It is evident that summer crops particularly in Rabts and Kmashat will need frequent and copious irrigations, and that winter crops should be given some form of supplementary watering.

## RAINFALL ZONES

Following Fantoli's climatic divisions based on annual rainfall of Tripolitania (Fig.9). The Jebel Garian may be divided into two sub-regions:-

1. Garian region has rainfall zone between 200-350 mms.
2. Ghibla region has annual rainfall between 100-200 mms.
1. The Garian region is large and extends westwards as far as Yefren and Jiado, whilst its extension eastwards is as far as Misurata and Homs. This zone of the Jebel has certain geomorphological features which appear in existence of plateau lands of Guasem, Asabaa and Orban. Those uplands of the Jebel, owing to their height, can catch more rainfall than the Ghibla.
2. The Ghibla region occupies the largest proportion of the Jebel and involves the whole southern part. This zone is regarded as semi-desert particularly in the deep south of the Ghibla.

## TEMPERATURES

The thermal conditions at the Jebel Garian are not greatly dissimilar to the conditions which influence the coastal zone of Tripolitania. The only differences are caused by altitude of the mountain and its remoteness from the sea.<sup>(12)</sup> Both regions are affected by high temperatures during summer and low temperatures during winter. At the coast the temperatures are moderated by the cooling influence of the Mediterranean during the day and in summer

by the relative warmth of the sea in winter and the night. The Jebel, on the other hand, is affected by the arid conditions which are dominant in the southern parts of Tripolitania. The average annual temperature in the Jebel Garian is lower than elsewhere in northern Tripolitania. For example, the mean annual maximum at Tripoli is  $24.3^{\circ}\text{C}$  whilst at Garian it is  $23.1^{\circ}\text{C}$ . At Azizia the mean is  $28.3^{\circ}\text{C}$  and at Yefren, Tarhuna, Beni Ulid and Mizda the mean maxima are higher than at Garian. At the same time, the mean annual minimum at Tripoli is  $14.8^{\circ}\text{C}$ , at Garian it is  $12.9^{\circ}\text{C}$ . This minimum is at Garian lower than the other towns mentioned above.

The thermal conditions of the Jebel differ from north to south. In the north, they are lower than in the south, whilst the former is affected to some extent by Mediterranean influences, the latter is affected more by continental conditions. This slight difference between the northern and the southern areas affects economic activity. The northern zones are more suitable for sedentary agriculture, whilst the southern zones are more favourable for shifting cultivation and pastoralism.

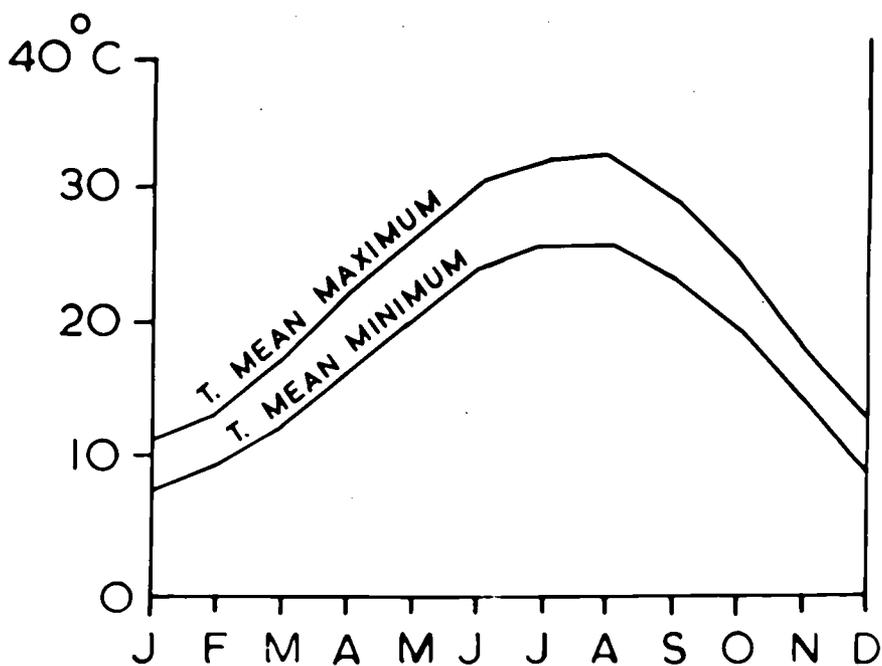
The monthly averages of temperatures for Garian town can be taken as an example for the northern zones of the Jebel for the period 1924-1956.

<u>Month</u>	<u>Maximum mean °C.</u>	<u>Minimum mean °C.</u>	<u>General average °C.</u>	<u>Extreme Maximum °C.</u>	<u>Extreme Minimum °C.</u>
January	11.8	4.8	8.3	24.6	- 4.8
February	13.9	6.1	10.0	34.1	- 3.4
March	17.7	7.8	12.7	33.7	- 0.2
April	22.7	11.3	17.0	38.1	2.4
May	26.8	14.6	20.7	42.0	6.1
June	31.0	18.4	26.5	42.2	9.3
July	32.6	20.4	26.8	44.8	12.1
August	32.8	20.7	24.1	44.0	9.8
September	29.9	18.3	20.4	41.2	11.0
October	25.4	15.4	15.3	42.1	6.8
November	19.2	11.3	9.9	32.0	2.0
December	13.6	6.1	18.0	25.0	- 2.4

These figures show that the temperature conditions in the Jebel are characterised by great variation between summer and winter. The mean maximum of the hottest month (August) reached 32.8°C., whilst the mean maximum of the coldest month (January) is only 4.8°C. Mean maximum temperatures increase from February to August and decline from September to January, (Fig. 14). The rapid rise in temperatures during spring is equalled by the rapid decline of temperatures in autumn.

The effect of the hot Ghibli wind is to raise the maximum temperatures during spring and summer and sometimes even in January and February. On the other hand, the extreme minimum temperature occurs in March 0.2°C. Throughout December,

FIG. 14 TEMPERATURE REGIME AT  
GARIAN TOWN (27 YEARS)



January, February and March, nocturnal frosts are very common.

The cloud cover, however, modifies both day and night temperatures in the winter months by limiting insolation during the day and preventing excessive radiation during the night.

With regard to the extensive zone of the Jebel, there is no meteorological station, but the thermal conditions must be similar to those of Beni Ulid (to the south-east of the Jebel). It can be taken as an example for the southern zones of the Jebel for a period of 20 years.

<u>Month</u>	<u>Mean Maximum</u> °C.	<u>Mean Minimum</u> °C.	<u>General Mean</u> °C.	<u>Extreme Maximum</u> °C.	<u>Extreme Minimum</u> °C.
January	17.2	5.8	11.5	31.0	- 1.0
February	19.0	7.0	13.0	35.2	0.0
March	22.5	8.9	15.7	39.1	1.2
April	27.4	11.9	19.7	45.8	3.1
May	31.5	14.7	23.1	48.4	7.2
June	36.1	19.0	27.6	56.8	10.3
July	37.7	21.0	29.4	50.6	10.0
August	36.9	21.0	29.0	49.5	13.1
September	34.0	19.7	26.8	46.1	10.3
October	29.0	16.6	22.8	40.5	6.5
November	23.7	11.5	17.6	33.7	3.1
December	18.6	6.9	12.8	34.7	0.0

Figures show that the maximum temperatures of July is 37.7°C. while the mean maximum of January is only 17.2°C. The mean

minimum of July is 21.0°C. and the mean minimum of January is 5.8°C. There is also a great difference between day and night mean maximum and minimum temperatures.

Comparing these figures with Garian Station's figures, it seems clear that there is 5.0°C. difference between the north and south of the Jebel in the mean maximum for the hottest month, and a similar difference in the mean minimum temperatures of this month.

Generally speaking, the less marked variations of temperatures in the north have an immediate impact upon the sedentary cultivators of the Jebel. Moreover, heavy dew following cloudless nights has a certain beneficial effect in adding slightly to soil and plant moisture. On the other hand, high day temperatures and low night temperatures can cause extensive damage to maturing wheat and barley especially at the beginning of summer.

Moreover, the extreme diurnal variations in temperature during the pollinating phase in the Berber and Arab gardens can cause serious loss in the quantity and quality of tree fruits and especially tobacco which is regarded as a very sensitive plant. Sometimes frosts cause loss of young trees particularly in March. Nevertheless, some fruit trees such as the date palms are well adapted to low temperatures.

The relative frequency or absence of low temperatures and associated ground frost is of great importance in the spring months. Olives, almonds and tobacco are exceedingly vulnerable

to frost even if they last for only a short period and are localised to hollow and shallow depressions. So far, there are no figures available to show the frequency of frosts on the Jebel, although they occur throughout the region. The highest incidence of frosts according to farmers falls in January, although frosts have been recorded as late as May in the Jebel. In specific areas of Garian such as in Wadi el Nakhle, Slahat, Wadi el Arbau and the oases of both Rabts, frosts are less frequent than the high lands.

#### INDEX OF ARIDITY

Rainfall figures alone are not an adequate guide to the aridity of an area, particularly one of marginal dryland agriculture. It is essential to correlate rainfall with other climatic data. In Tripolitania, this must be limited to temperature since data on evaporation dew etc., is absent. Of the formulæ available, it was found that the most applicable were those of De Martonne, Emberger and Koppen. Those of Emberger and De Martonne give almost identical results. De Martonne's formula, which divides the precipitation in millimetres by the temperature in degrees centigrade plus 10, is one of the earliest attempts to establish an index of aridity. De Martonne classed the resultant indices into three groups:-<sup>(14)</sup>

Over 20 - Exric, drainage to the sea.

10-20 - Endoric, drainage to inland basins.

Under 10 - Areic, no surface flow.

The Jebel Garian falls into the second classification, since it has 1252. The index of 10 is approximately the boundary between steppe and desert.

Yearly indices of aridity are however misleading because of the marked seasonal nature of the rainfall. Monthly indices can easily be worked out from the formula  $\frac{12P}{t+10}$ , where P = monthly rainfall in millimetres and t = monthly temperature in degrees centigrade.

Monthly indices of aridity for Garian Station.

<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>
4.6	9.9	19.2	31.9	51.2	33.0	24.8	8.0	5.7	0.6	0.2	0.3

All the six months April to September have an index below 8 and June, July and August are below 1. There is likely to be wadi flow in any of the months from October to March.

Semi-annual or winter indices of aridity in Tripolitania.

<u>Coast</u>		<u>Jefara</u>	
Tripoli	26.8	Castel Benito	20.9
Castel Verdi	22.8	Azizia	14.3
Zuara Marina	15.9	Bir el Ghen	7.8
Zaira	19.2		
Homs	17.2		
Zliten Marina	15.8		
Misurata	17.4		
Sirte	11.5		

<u>Jebel</u>		<u>Ghibla</u>	
Jiado	17.3	Mizda	3.6
Yefren	20.9	Beni Ulid	3.5
<u>Garian</u>	25.6		
Tarhuna	19.0		

It is clear from the winter indices of Tripolitania that cultivation must be restricted to the winter months unless the area is irrigated when in any case evaporation rates might be too high for efficiency. The winter index of aridity at Garian is 25.4 which is clearly in the exoric class. The value of the winter index is that it may be compared with general index curves throughout the world. Thus, the index curve for 10 seems to define the zones of dryland cereal cultivation whilst the boundary for oilve cultivation falls between 10 and 15. The general boundary for dryland agriculture is about 20. It is clear that during the winter months Garian is suitable for dryland agriculture particularly of the olive and cereals. Given the high summer aridity, the crops must always be the hardier specimens adapted to Mediterranean droughts.

#### WINDS

As a whole the north-west winds tend to be of greater frequency in spring than in winter and tend also to be of greater velocity. Throughout the summer, north-west winds are dominant although they are less strong in spring. In autumn again, the north-westerlies are important. Southerly winds are prominent

in autumn when they are stronger than at the other seasons. (Unfortunately, there is no available data for frequency of wind reading at Garian Station.)

The Ghibli (the direction from which the wind blows supplies its name in Arabic) is a manifestation of the variability of climatic conditions in the Jebel. It forms a hot dry current of Tropical air moving from the south and south-west to the north across the Jebel. Normally, it moves north over the east side of a depression over the Mediterranean or north-west Africa.<sup>(15)</sup> During the spring months the Ghibli is associated with low pressure systems from the Atlantic which are moving more or less parallel to the North African coast. In late spring and summer it is believed likely that Ghibli are the result of cyclonic conditions which have developed over the western Sahara. However the size of the area affected depends largely on the synoptic situation which is modified by the local factors of relief, aspect and position, but whether a deep depression in the northern parts of the Mediterranean or a minor one over Tunisia, Algeria and Morocco, almost the whole of this zone comes entirely under its influence.

The Ghibli is responsible for a sharp reduction in atmospheric humidity with a rapid increase in temperature. It may raise temperatures to a maximum of 50°C and reduce relative humidity to 0-10%. Its dryness causes an increased transpiration from plants and immediate evaporation from the soil. Moreover, the

Ghibli also leads to the diffusion of the eye disease Trachoma which is considered the most widespread disease among the population of the Jebel.

When the Ghiblis are strong, they move the dunes and heat is normally accompanied by sand which disturbs the vegetation cover. They cause also misuse of the soil for example by grubbing of plants for fuel or by overgrazing. The effects of this mismanagement of the soil can be seen in the more cultivated areas of the Jebel.

On the other hand, the Ghibli is essential for the maturing of the date harvest in the late summer by hastening its ripening, If the Ghibli fail to blow in the autumn, there is the hazard that the date crop may not mature, and both quality and quantity of the harvest may be reduced. It is most frequent in the early and late summer (periods of critical rainfall) and may arrive in November and early spring. The duration of the Ghibli is normally no longer than three days but it may blow up to five and rare cases to eleven days. During the Ghibli, outside activity is impossible and all agricultural work stops until the wind ceases. Both Berber and Arab gardens are endangered by the bad effects of this wind which sometimes cause the death of plants especially tobacco and vegetables. In general, the Ghibli is modified in the Jebel by local variations in relief and exposure.

#### CLOUDS

The region is generally cloudless because of the effect of the

arid air descending from the Sahara desert. Garian meteorological Station reveals that there is some cloud from November to April, while from June to September the sky is almost cloudless. Unfortunately, there is no available data showing the mean total amount. In winter time fog may be noted some mornings, when conditions are calm in the lower air layer above the ground surface, but it lifts when the sun rises to the sky.

VISIBILITY can be described as excellent in the Jebel because the average humidity is low and temperature is high. The Ghibli wind sometimes spoils visibility as it produces fine dust and sand material which make the visibility difficult.

#### PRINCIPAL EFFECTS OF CLIMATE ON LIFE AND LANDFORMS.

One of the most significant climatic problems is that during the six months of summer aridity the amount of moisture in the soil is negligible. This means that dry land agriculture must be restricted to crops which can resist the fierce drought conditions or to winter crops. This means that fruit trees, for instance, must be considered as marginal crops in the Jebel. The intense but highly variable nature of the rainfall results, in, on one hand, uncertainty of yield and on the other in destruction of the soil material and occasionally crops. All these factors add up to insecurity particular in sedentary agriculture. The same factors also tend to encourage nomadism and pastoralism which aim to counteract the unreliable climate by mobility.

Rainfall also profoundly influences landforms principally

through the agencies of fluvial erosion. Sheet, erosion, rilling and gully are characteristic whilst the wadi spate tears from the land its soil material and deposits alluviums and coarse gravels in the lower sections of its often narrow deeply scoured wadi course. This results above all from the highly intense nature of rainfall. The indigenous cultivators seek to restrain the power of the spate by the construction of earth terraces and dams, which together with the small excavations around the feet of trees also serve to direct to the crops its aqueous life blood.

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## CHAPTER III

### RELIEF

The Jebel and the Jefara are the two important morphological units of Northern Tripolitania. In the Cretaceous, Northern Tripolitania was dominated by one huge dome-shaped anticline that stretched from Tabarka to Homs and from the coast to the Hamada el Hamra. <sup>(1)</sup> The northern limb of the anticline was downfaulted in the post-Cretaceous, the line of faulting lying about 3-5 kilometres north of the present Jebel scarp. The downfaulted zone - the Jefara - was later covered by marine and continental deposits so that today it is a vast sandy and almost featureless plain. Normal regressive erosion has been responsible for the retreat south of the Jebel scarp, which abruptly terminates the Jebel plateau.

Lipparini <sup>(2)</sup> states that the axis of the anticline lay northwest - southeast between Tabarka and Garian - Azizia in Tripolitania. The remaining sections of this zone are today visible in the higher elevation of Garian compared with the Jebel Nefusa and Tarhuna. Outcrops of volcanic rocks in the Garian zone give the areas distinctive features. It may thus be differentiated from the Jefara and Hamada to the north and south and from Tarhuna and Nefusa to the east and west. <sup>(3)</sup>

A section across the Jebel Garian from north to south shows the following features:- (see fig. 15 )

1. The main escarpment - the Bu Gheilan escarpment. This is a steep cliff-like scarp slope that rises from the Jefara at 250 metres to over 460 metres.

FIG. 15

SECTION ACROSS TRIPOLITANIA FROM NORTH TO SOUTH. VERTICAL SCALE IS EXAGGERATED ABOUT 30 TIMES

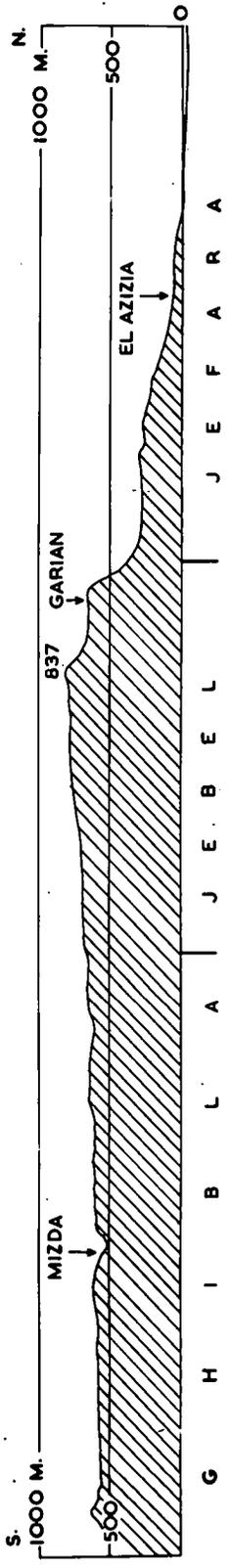
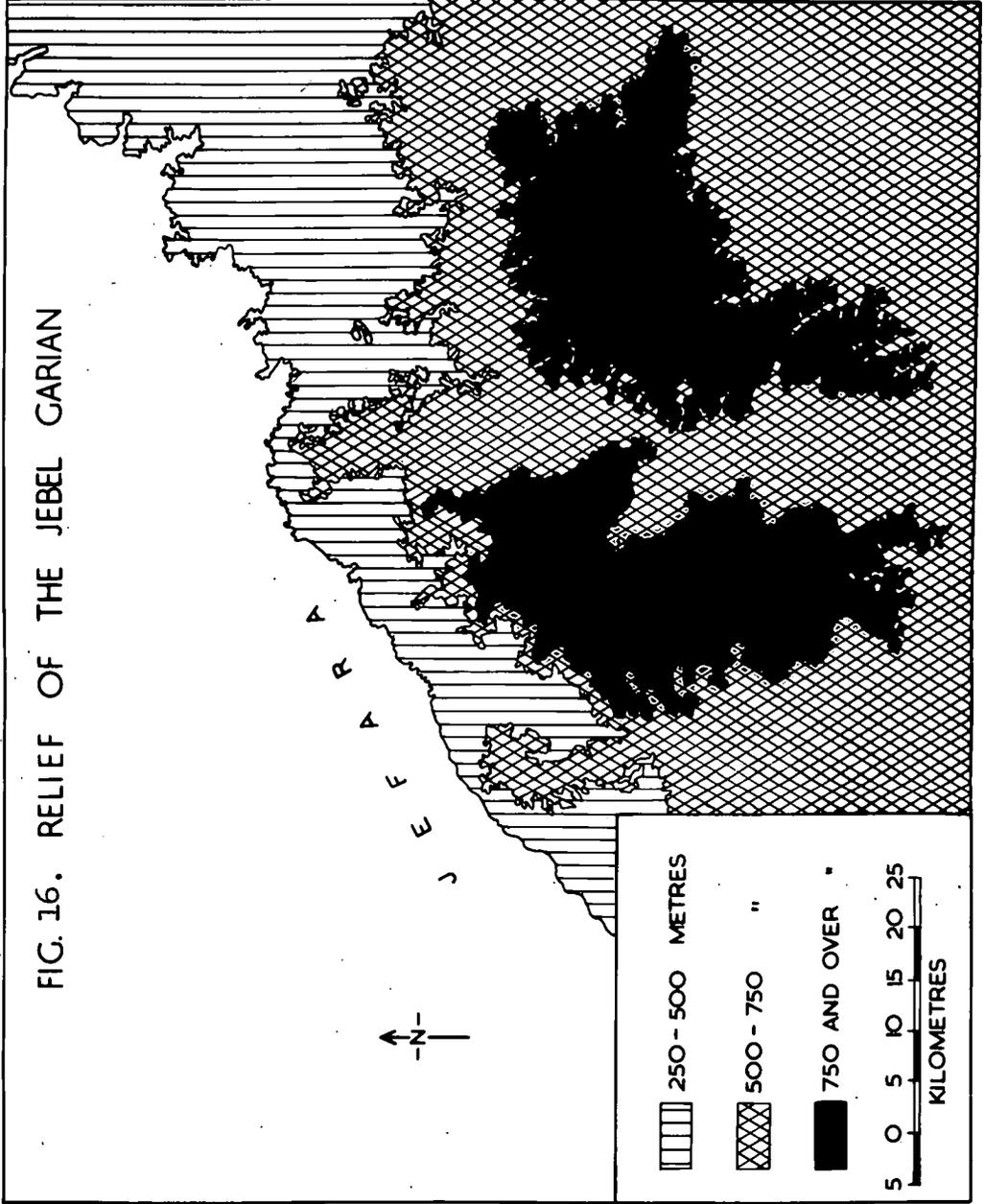


FIG. 16. RELIEF OF THE JEBEL GARIAN



2. A gently sloping plateau zone lying south of the scarp. This is the Guasem plateau.
3. A secondary scarp at Ain Tobi. This scarp is erosional in origin being related to the outcrop of hard siliceous limestones. It rises from the Guasem plateau at 600 metres to a second plateau with an elevation of about 750-800 metres.
4. The second plateau. This is the Asabaa plateau and it slopes gently southward from a maximum elevation of 847 metres at the main watershed.
5. From the main watershed, the land slopes gently southward to the Ghibla and Mizda.

In addition, there is a general east-west slope associated with the volcanic intrusions. The west is generally much more dissected than the east.

The study of the morphology will be based on an examination of surfaces and slope and wadi erosion.

#### A. The Surfaces.

Four distinct plateaux may be recognised in the Jebel Garian. These correspond to the main surfaces (see fig.16 ).

1. The Guasem plateau. The Guasem plateau is roughly triangular in shape with its apex in northwestern Garian and widening eastwards. It is defined by the two main scarp formations. The plateau varies in level between 250-500 metres. The eastern section is flat to undulating and is well suited to agricultural activities. The western section is much more broken and is dissected by numerous large wadis flowing from the central part

of Garian northwards to the Jefara. The zones between the wadis are, however, of rounded features and the wadi valleys are very wide and well-developed.

2. The Tigrinna plateau occupies the central zone of Garian being narrow and defined by the watershed plateaux of Orban and Asabaa and the Ain Tobi scarp. Elevation varies between 500 and 750 metres above sea-level. The western section is generally flat or gently undulating but east of the Wadi Gan it is deeply dissected and broken by numerous wadis. The extreme west, however, is steeper and more influenced by fluvial erosion. To the south, there are extensive level zones broken by the steep slopes of the deeply incised but broad wadis.

3. The Asabaa Plateau occupies the whole of Asabaa and extensive sections of western Garian. The plateau surface lies at about 750 metres above sea-level. To the northeast, the plateau is narrowly defined between the steep wadis but to the south the land slopes gently towards the Ghibla. Here, most of the Asabaa tribes are concentrated. The central part of the plateau is transitional being largely effected by the upper tributaries of the Soffeggèn. The southwest is more broken associated with the watershed between Garian and Mizda.

4. Orban plateau lies to the eastern part of the Jebel. It is extensive being situated between the Tigrinna plateau and the eastern confine of Tarhuna. It is about 43 kilometres long and 38 kilometres broad. The general level of the plateau is about 750 metres long and is thus related to the Asabaa plateau. It

may be differentiated from the latter by the fact that the Asabaa plateau is much more broken. The northern part of the Orban plateau is formed by regular rounded features with, however, much more broken area with sharper landforms on the eastern extremities. The plateau contains many major summits such as the Ras Zaguana, Ras Sciabet, and the Ras Um er Naag. In the south, the major summits are the Ras el Brega, Ras Msula, Ras el Botros etc. These are associated with the steeper sloping and more vigorous mountain forms of the watershed zone. The full scale of slope associated with an arid mountain region are to be observed in this and the Asabaa plateaux.

B. Wadis (see fig. 17 ).

The hydrographic pattern of the Jebel Garian falls into two major regions: wadis draining to the Jefara in the north, and wadis draining to the Soffeggen in the south. The water divide lies at about 900 metres in southern Garian. However, the zone of north-flowing drainage may be further divided into western and eastern sections. The former drain northwest to the Jefara whilst the latter flow more directly northwards. The water divide between these systems is well marked in the Tigrinna plateau.

The western wadis are generally much less mature. They are steeply sloped between incised beds and gorges falling from 750 metres to less than 250 metres over distances of less than 30 kilometres. The erosive power of these wadis is extremely strong.

The wadi systems of the east and central parts of Garian are more mature. They are longer with much more development of



tributaries and minor feeders. The upper basins of these wadis are characterized by their deep incision between steeply sided channels and the rough and often bare floors. In the upper basins, run-off leads to vertical corrasion and the cutting back of the floor which corresponds to the 250 metre base level of the Jefara through the plateaux of the Jebel Garian. The lower courses are much more mature since erosion is more advanced. The wadi courses are gently sloped and are normally very wide. In this, lateral corrasion is of greater importance but extensive alluvial deposits are found. Fig 18,19 shows the selected wadi profiles and transverses of the Jebel.

The best method of examining the development of erosion in these wadis is to examine the more important talwegs, bearing in mind that the main object is to assess the relative influence of relief on agricultural activity.

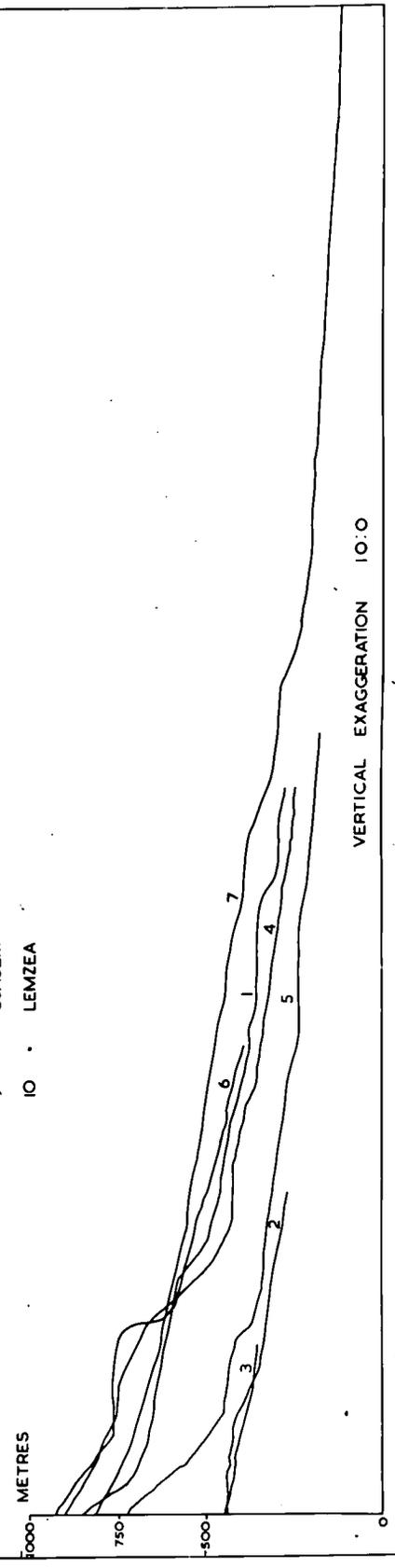
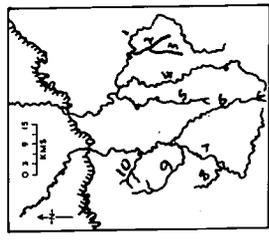
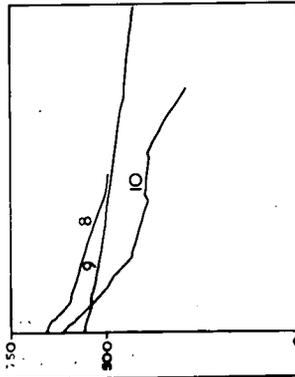
The main wadis and their tributaries are shown in fig. 17 .

They are:-

1. Wadi el Hammam.
2. Wadi el Hesi            Wadi Mazghiuen.
3. Wadi Bir el Uaar
4. Wadi Gheddaf el Dam, Wadis el Guer, Sceget el Hman, el Hiafa, el Gseba and el Naggria
5. Wadi Gan. Wadis Sidi Khalifa, Sighin, el Guasem, Mtalis, Lemzua, Marghnia, es-Sciabat es Soda.
6. Wadi Zaret. Wadis Misca, Crema, Bibuck.
7. Wadi Slulu
8. Wadi es-Scialia, Wadi Uasada
9. Wadi el Arbaa. Wadi Zaggut

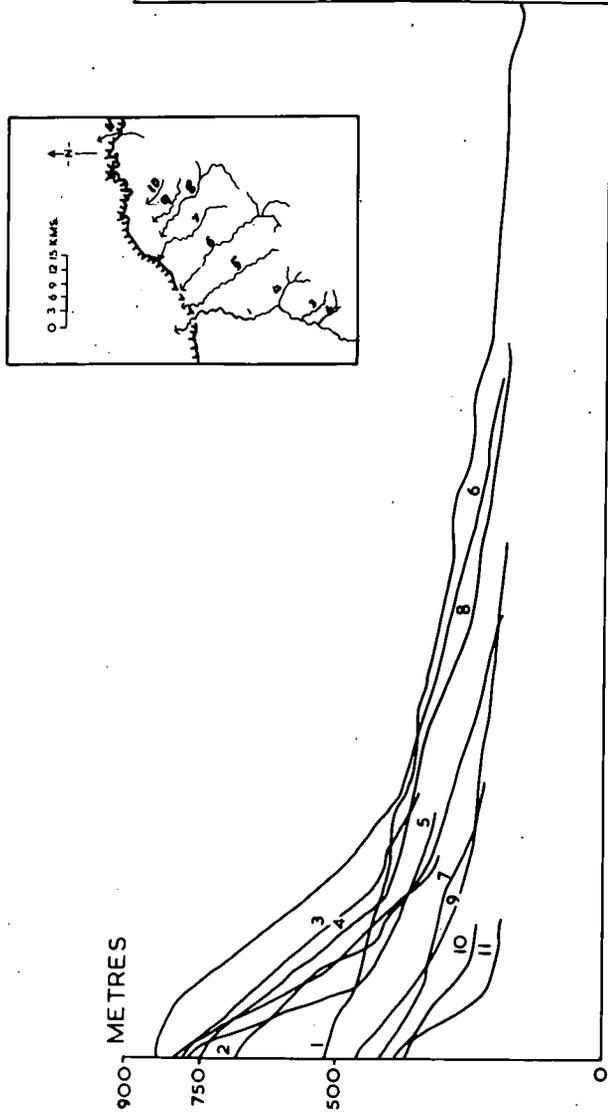
FIG.18a WADI PROFILES

- 1 WADI HAMMAN
- 2 " HESA
- 3 " MAZHUEH
- 4 " EL UAAR
- 5 " GHEDDAF EL DAM
- 6 " MARGHANIA
- 7 " GAN
- 8 " SIGHIN
- 9 " GUASEM
- 10 " LEMZEA



VERTICAL EXAGGERATION 10:0

FIG.18b WADI PROFILES



VERTICAL EXAGGERATION 10:0

- |               |                   |
|---------------|-------------------|
| 1. WADI ZARET | 7. WADI SHEHIA    |
| 2. " MISCA    | 8. " BU SHEBA     |
| 3. " CREMA    | 9. " BENI YEKHLIF |
| 4. " BIBUCK   | 10. " MTANIN      |
| 5. " SLULU    | 11. " BU GHEILAN  |
| 6. " ELARBAA  |                   |

FIG.19a TRANSVERSE WADIS

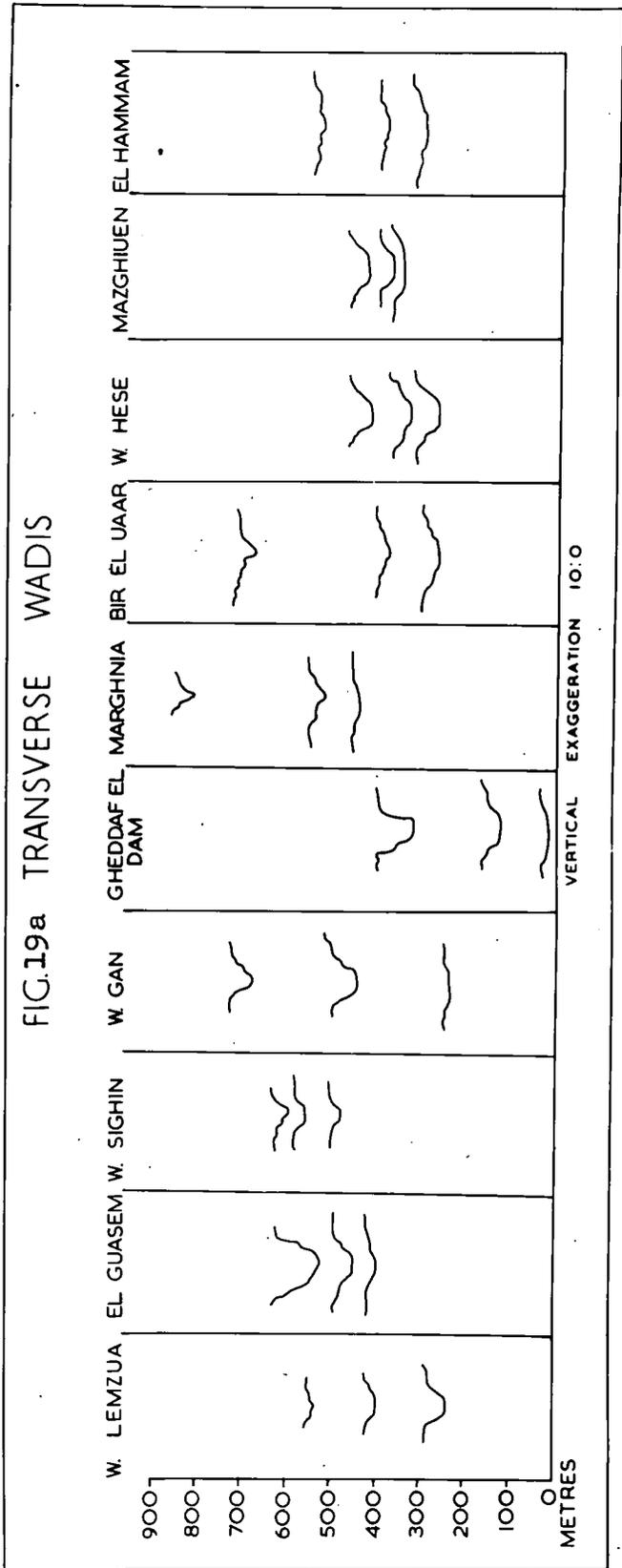
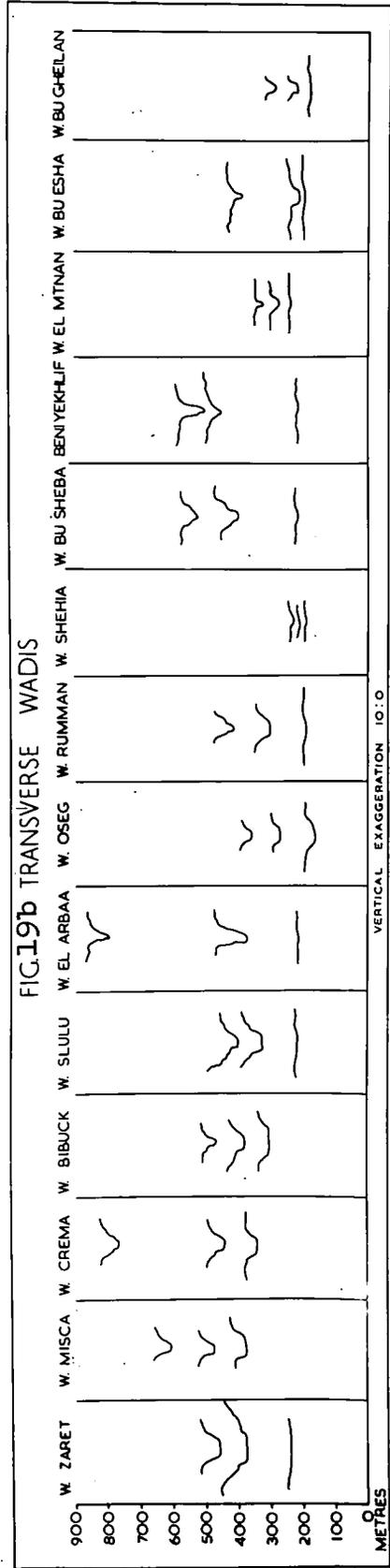


FIG.19b TRANSVERSE WADIS



10. Wadi esh Shehia. Wadi Sheaabat el Osag. Wadi el Rumman
11. Wadi Bu Sheba
12. Wadi Beni Yekhlif
13. Wadi Gheltet Mttan
14. Wadi Bu esha
15. Wadi Bu Gheilan.

1. Wadi el Hammam. This wadi rises on the slopes of the Glab el Hagera and first flows to the northeast but turns to the northwest to join the Wadi el Uaar. The wadi which is 43 kilometres long, drains an extensive area. Its watershed with the Wadi Uaar is particularly steep and erosion and undercutting is very active. The upper part of the wadi is formed by numerous feeders which flow through deeply incised immature channels into the main wadi. However, north of Hosh Bu Galia the course is incised in a deep gorge-like formation cut in the hard limestones. The wadi widens further north, with a broad silt covered floor and steep high banks. (Plate 2).

2. Wadi Hesi. The Wadi Hesi drains the Ras Hman and the Ras Daccara. From here, it flows north for 4 kilometres whence it curves first to the west and then the northwest to join the Wadi Bir el Uaar. The wadi is  $17\frac{1}{2}$  kilometres long and falls with an average slope of 22 metres<sup>per</sup>/kilometre. The upper course is similar to that of the Hammam but the cycle of erosion is more advanced. The wadi floor is wider and the alluvial deposits are used for shifting cereal cultivation based on either the natural irrigation of the Wadi Spate or on the springs in the lower part of the wadi course. This section of the wadi is settled by Orban

cabilos in the summer months. Its largest tributary is the Wadi Mazhiuen which joins the wadi from the east.

3. Wadi Bir el Uaar. The Wadi Bir el Uaar is one of the longest and largest wadis of the Mejenine system. It is 45 kilometres long and flows from the extreme southern section of the Jebel-Orfella watershed. Its direction is north-south. The wadi crosses three main plateaux: Orban, Tigrinna and Guasem. It is deeply gorged in the volcanic effusives of Orban and the Garian, Tigrinna and Ain Töbi limestones of the Tigrinna and Guasem plateaux. It drains an extensive but narrow zone. The agencies of fluvial erosion are sharply controlled by the Jafara base level so that in its lower sections the wadi is characterized by a wide steeply encased floor with numerous small immature feeders whilst the upper course assumes the features of its lower feeders.

4. The Wadi Gheddaf el Dam. This wadi rises on the slopes of the Argub Fras and Ras Bibel at an altitude of 750 metres. It flows north to join the Bir el Uaar and is the most western of the Mejenine feeders and is 41 kilometres long. The wadi basin is fairly narrow with considerable competition for run-off between the tributaries of this and the neighbouring regimes. Wadi capture is clearly manifest on the maps. Several of the tributaries of the Gheddaf el Dam have captured the heads of the tributaries of the Wadi Gan. This also accounts for the greater number of tributaries that join the wadi from the east compared with the west. This is due to the fact that the base

level of the Gheddaf el Dam is lower than that of the Gan.

The above wadis are the main feeders of the Mejenine. The Mejenine is the most important wadi of the Jebel since it is the only one, apart from some smaller wadis in Cussabat, in which the winter spates occasionally discharge into the sea. The drainage area is vast and with a run-off rate of 10% of rainfall millions of gallons of water are discharged from the Jebel each winter.

The economic value of these wadis is limited. Only the floors in the lower courses are suited to shifting cultivation whilst the floors are too encased to permit water spreading on a large scale.

5. Wadi Marghnia. This is the most important tributary of the Wadi Gan-elHira system. It flows northwards from the main watershed being deeply gorged as far as Gasr el Marghnia. It is 29 kilometres long. Here, the course widens running to the north-west where it eventually joins the Wadi Gan at 394 metres, falling at a rate of 11 metres per kilometre. The upper course is encased in the volcanics whilst the middle course cuts through the Tigrinna limestones and then the Garian series.

6. Wadi Gan. The Wadi Gan is 74 kilometres long rising at the main watershed at 870 metres and entering the Jefara at 200 metres. The upper course is narrow and incised in the volcanics. Here, vertical corrasion of the sides is important and a gorge-like valley is produced. Down-cutting proceeds rapidly. Lateral corrasion in the lower course is manifest in the wide valley

floor and the extensive alluvial deposits. The intense nature of winter rainfall means that run-off is concentrated in the wadi channels giving rise to short but violent floods. In the upper courses, run-off fills the channels since the underlying formations lead to little infiltration. In the lower parts of the wadi course, run-off is absorbed but the numerous feeders maintain the volume of the spate. The spate is strong and dangerous but does provide a form of natural irrigation in the flood plain. The water eventually disappears into the Jefara to feed the Quaternary aquifers. There are, however, numerous springs along the wadi courses, which means that dry olive cultivation can take place in the wider sections since there is sufficient water for domestic and stock use. There is one small attempt at water conservation in the Gan but the problem of silting has not yet been overcome.

The major tributaries are:-

a) The Wadi Sighin. This rises from Gahasat and Bu Maad. It falls from 750 metres to 510 metres and is thus typical of the upper course immature wadis. It is 12 kilometres long. Slope is very steep being 27 metres per kilometre. There is one perennial spring but since there is no agricultural land available in the narrow and steep wadi, it is used solely by semi-nomads.

**Wadi el Guasem**

b) This important tributary drains the slopes of the Bu Gheilan, flowing northwest to join the Gan. It is 17 kilometres long and flows across the Guasem plateau cutting deeply into the

limestones. However, it is a lower course tributary being gently sloped - 9 metres per kilometre. The watersheds are marked by cliff-like slopes but the wadi floor falls gently to the channel. It has been covered with aeolian loess and alluvial depositions. The wadi forms the base of the most fertile area in Garian.

c) Wadi Lemzua. This is similar to the Guasem. Slope is steeper - 19 metres per kilometre and the course is narrower and more deeply incised. It is 10 kilometres long. As a result, there is extensive erosion of the aeolian loess which is deposited in a large alluvial fan at its junction with the Gan.

7. Wadi Zaret. This is the largest of the wadis in the western drainage system. It forms the boundary between Garian and Kikla. It rises from the south at 476 metres flowing first to the northeast and then the northwest to reach the Jefara at 184 metres. It is 39 kilometres long but falls at only 7 metres per kilometre. Fig. 19B shows that the wadi corresponds to the typical Jebel pattern with a narrow and deep upper course and a very wide lower course. The basin is vast spreading over most of western Garian and eastern Kikla with, however, gently sloped western tributaries and deeply incised immature eastern tributaries. Erosion is more advanced to the Asabaa bank indicating that the wadi captured south-flowing streams in the early Pleistocene. The wadi gives extensive stretches of agricultural land and there are two major springs at Taghait and en-Nagher.

There are three important tributaries:-

a) Wadi Misca. This rises from the spring of Ain Misca

flowing from 757 metres to 373 metres where it joins the Zaret. It falls at a rate of 38 metres per kilometre and is typical of the eastern tributaries. It is important because of the alluvial deposits in its lower course which together with the springs form the basis for arboriculture.

b) Crema. The Wadi Crema lies to the north of the Wadi Misca flowing from Sidi Abd Maaruf (southwest of Asabaa village) to the northwest though the middle course swings to the west. The wadi is steeply sloped falling from 800 metres to 353 metres at 44 metres per kilometre. There are again springs in the wadi bed which form the base of agricultural activity.

c) Wadi Bibuck. This is the largest tributary draining Sidi Mohammed ~~Rakuma~~ on the Tigrinna plateau. It falls at a slope of 13 metres per kilometre. Fig.19B shows that the wadi course is steeply sloped in its upper course but again wide in its lower sections. This wadi has eroded an extensive area at the foot of the Jebel and in the Asabaa highland. This is clearly marked on the map as a depression between the higher zones of Bu Grara and Khashm el Uaar. The wadi basin itself extends to the north, east and south. There is one small spring in the wadi at Ain el Deccara whilst the alluvial deposits provide soil material for shifting cultivation and limited irrigated arboriculture.

8. Wadi Slulu. This wadi rises in the Asabaa plateau draining the slopes of the Ras Nezzi and the Khashm el Uaar. Over its length of 17 kilometres it slopes at a rate of 35 metres per kilometre. A permanent spring at Ain Hasnun forms

its main resource.

9. Wadi Uasada. Wadi Uasada drains the Um el Maaruf at the foot of the Jebel, and flows from 350 metres above sea-level to 200 metres over 10 kilometres. It is a short wadi but it is typical of those along the Jefara-Jebel front. It is deeply incised in the Pleistocene loess. The loess is subjected to intense gullying and sheet erosion and the eroded materials are transported to build up the alluvium of the Gattis plain.

10. Wadi el Arbaa. It falls from the Tigrinna plateau running to the northwest with its western feeders eroding the limestones of the Asabaa plateau and is 30 kilometres long. The wadi rises at 800 metres above sea-level sloping at a rate of 39 metres per kilometre. This wadi is interesting on account of the depth of its incision. Fig.19B shows transverse profiles in the upper course. The course is gorge-like between the Garian limestones and the floor lies 50 metres below the top of the banks. The wadi has few western feeders since again this section is more advanced in the cycle of erosion. On its eastern side, numerous small and immature feeders join the wadi. There are several springs in the wadi so that in a part of its course there is a perennial water flow in the surface. Here, vegetation and agriculture are found and the ruins of Berber villages shows that the wadi has long been favoured as a settlement site.

11. Wadi Shehia. This wadi is in fact a small section of a larger system fed by two major tributaries - the Rumman and el Osag.

a) Wadi el Rumman. This wadi drains the Caf el Cullan and Caf Tuent. It is  $7\frac{1}{2}$  kilometres long with an average slope of 32 metres per kilometre.

b) Wadi Sheaabat el Osag. This is much smaller, draining the slopes of the Caf Tahshent. Both wadis are typically immature. However, there are important springs in both - Ain Suenia in the Osag and Ain es Shahia in the Shahia. The valley sides are used for cereal cultivation.

12. Wadi Bu Sheha. This is the third most important of the western wadis. Its source lies on the slopes of the Bu Gannish and Caf Taieh from which the wadi flows northwest to Gattis. The wadi basin is extensive but the confines are abruptly defined by steep sided watersheds. The wadi is 30 kilometres long with a slope of 17 metres per kilometre. The upper, middle and lower courses are typical, except that the wadi flows through an extensive area of softer sandstones. The wadi channel is cut in large quaternary terraces which are employed in cereal cultivation.

13. Wadi Beni Yekhlif. This short and steep wadi is typical of the immature talwegs of Garian. It is important because of the groundwater resources of Ain Sdendu.

14. Wadi el Mtnan. Draining the western section of the Jebel scarp, this wadi is very short and steep. It is typical of the run-off gullies that have developed into wadis along the Jebel front. These gullies through processes of normal regressive erosion have extended their channels to form the greater wadis.

The Mtnan shows one early stage in the process of regression.

15. Wadi Bu esha. This is similar to the Mtnan draining the Bu Gheilan area.

16. Wadi Bu Gheilan. This wadi together with the Bu esha has eroded the Jebel front to its present cliff-like dimensions. Both have reached only the early stages of wadi development responding to the base level of the Jefara.

The foregoing examination of wadis shows that the talwegs are often closely similar. This is because of the evolution. After the destruction of the Jebel through the down-faulting of the northern limb, the hydrographic pattern was altered. The faulting meant that the wadis of the Jebel were responding to a distant southerly base level and the newly created Jefara. On the edge of the scarp, run-off rills and gullies developed. Examples of these features may be seen along the whole length of the Jebel. Eventually, the rills expanded and run-off concentrated in the larger gullies. By the process of regressive erosion the courses were extended to their present dimensions. Examples of the young wadis are found in the Bu esha and Bu Gheilan wadis. Wadis in the Jebel are formed by a series of tiers ranged along the wadi profile, so that there are a series of minor base levels. These are attacked by run-off and are gradually forced higher up the profile. Downstream, lateral corrasion becomes important as the base level is established in the wadi so that run-off attacks the wadi sides and so widens the course. Also, vast quantities of sediment are carried

downstream. This sediment has covered the ancient northern limb of the Jebel.

As the wadis cut back, they undermined and captured the headwaters of the south-flowing talwegs pushing the watershed further to the south. This process is still active along the watershed, and accounts for the many changes in the directions of the wadis.

Vast quantities of aeolian loess were deposited during the Pleistocene. This covered and buried the ancient pattern over large areas. Hence, the wadis are often encased between terraces composed of sand and alluvial deposits. These areas are of great value agriculturally.<sup>(4)</sup>

The fluvial erosion and the deposition of the aeolian loess have given to the landscape distinctive features. It is best to examine the mountain forms by reference to examples of various types of landform before considering in more detail the cycle of erosion.

### C. Mountain forms.

The following examples have been chosen to illustrate the nature of the mountain forms:-<sup>(5)</sup>

1. Ras Bu Gattas
2. Ras el Wadi
3. Bu Glidra and Grarat ed Daba
4. Henshir Gazmat
5. Kheshm el Uaar
6. Ras Nezzi
7. Caf Culaia

8. Ras el Tuent

9. Bu Gannush

10. Taf Tecut

11. Bu Gheilan

1. Ras Bu Gattas. The Ras Bu Gattas forms the watershed between the Wadi Misca and the Wadi Crema. It extends over an area of 6 square kilometres and its highest point is 821 metres above sea-level. Formed of limestones and sandstones, it has been severely dissected by the feeders of the Wadi Misca which, with the Crema, has isolated this summit from the Bu Glidra and the Ras el Wadi.

2. Ras el Wadi. This lies to the north-east of the Ras Bu Gattas and to the east of el Glidra. Its summit reaches 894 metres. Slope is gentle except to the south-west where it has been extensively ravined.

3. Bu Glidra and Grarat ed Daba. These two areas lie between the Wadis Bibuck and Crema. The Bu Glidra reaches 831 metres and the Grarat 841 metres. They show again a northern section of more mature slope compared with the western and southern dissected and gullied zones where the slopes are cliff-like. Further, the action of the wadis has led to the formation of a number of isolated hills.

4. Helshir el Gazmat lies to the south of the Wadi Bibuck whose feeders drain and dissect its slopes. The greatest elevation is 829 metres. The western slopes are gentle whilst the western parts are steep so that isolated hills have developed.

5. Khasham el Uaar lies in the watershed region between the Wadis Slulu, Bibuck and el Fahel. In the east, summits exceed 750 metres but to the west are below 650 metres. This mountain form is similar to these mentioned above.

6. Ras Nezzi. Situated between the Wadis Slulu and Arbaa, it reaches 705 metres. The Ras Nezzi has been influenced by active fluvial erosion particularly on its northern and southwestern faces. The downcutting is leading to the retreat of the slope and the formation of monadnockal landforms.

7. Caf el Culaia. Of the many mountainous zones between the Wadis Arbaa and Rumman, the most important is the Caf el Culaia, which reaches an elevation of 666 metres above sea-level. A caf is a mountain with a basaltic cap. This means that the slopes are normally very steep in the upper sections but more gentle lower down. Some of these basaltic mountains are of a sugar loaf shape particularly in the Bir el Uaar area. The Caf el Culaia is typical of these mountain forms.

8. Caf el Tuent lies between the Wadi Bu Sheba and the Wadi Rumman. It is an isolated feature associated with an intrusion of phonolite. It is similar to Caf el Culaia except that the mountain is more dome-shaped.

9. Bu Gannush is situated near Gariam town and is typical of the mountains developed on the Garian limestone. Its southern face has been deeply dissected and the inter-wadi slopes are denuded and bare. The northern face is more gently sloped with a large accumulation of scree at the foot. (Plate 3).

10. Caf Tecut. The Caf Tecut lies on the extreme western edge of the Guasem plateau. Its summit lies at 724 metres above sea-level. It conforms to the typical volcanic pattern but is unique in the Guasem zone where volcanic rocks are found only rarely.<sup>(4)</sup> (Plate 4).

11. Bu Gheilan. The Bu Gheilan is the first escarpment plateau. Its altitude varies between 323 metres and 612 metres and slopes are often steep. The active erosion along the Jebel scarp means that wadis responding to the Jefara base level are deeply incised and fluvial erosion is active. Indeed, this zone is similar to the watershed area and wadi and mountain slopes correspond in steepness to the scarp face itself. (Plate 5 ). The Bu Gheilan is sharply defined by the scarp. Below Bu Gheilan is found the piedmont zone of the Jebel where sediment and alluvium have been thickly deposited and subsequently ravined.

#### D. Cycle of Erosion.

The initial forms of the current cycle have been produced by upheaval, with folding and then fracturing during the Cretaceous. The erosion was thus initiated on an anticlinal surface, but altered by fracturing and down-faulting. The activity of the erosion agencies are found in the appearance of the wadis, rocky hills, denuded slopes, slope retreat and gullying. Both wind and water action have been active in the evolution of the present landscape. Lipparini<sup>(6)</sup> believes that fluvial action has been the strongest erosive force whilst aeolian action is restricted to deposition rather than abrasion.

As in other semi-arid regions, water has been the most important factor. Further, the nature of the rainfall regime shows that rainfall, though not high in volume, is restricted to the winter months and is intense in nature. Run-off attacks slope through sheet erosion and gullying. It concentrates in narrow wadi channels so that the intensity of erosion along the wadis is great. Further, infiltrated water often reappears in the wadi courses augmenting the power of erosion. The detritus is transported downstream and is either lodged in the wadi course or deposited in the alluvial fans and deltaic formations of the Jefara and Gattis. Jebel wadis, except for the Mejenine, deposit their alluvium in the Jafara where they discharge.

However, the deposition of materials in the Jefara leads to the building up of the land and the gradual raising of the base level. Thus, active fluvial erosion is levelling the Jebel whilst deposition is building up the Jefara.

Back-wearing and slope retreat are important features particularly along the watershed. Here the slopes are worn back rather than worn down. Under the influence of continual weathering the slopes, which often have been stripped of the soil mantle and vegetation, are always steep. This has been seen in the examination of the mountain forms.

The general effect of back-wearing is twofold. First, it pares back the mountains to smaller and smaller dimensions, isolated spurs and ridges. Secondly, it results in the

replacement of mountains by plains left progressively at the base of the retreating slopes. These plains are formed by bed-rock and are by no means level, though notably smooth. They tend to slope strongly to the remnant mountains.

Broad pediments are formed at the foot of the Jebel owing to the gradual destruction of the Jebel. These features can be seen particularly in the western parts of the Jebel. To the east, the much more gently sloped wadis do not show as well the pediments.

The plateaux of Tigrinna, Guasem and Assaba are dissected plateaux. The hills appear to have the same summit levels whilst the individual mountains have been cut and dissected by the wadis.

Gullying is a common feature on all slopes. Gullies are particularly dangerous on the soil mantle where they are the principal agencies of soil erosion. (Plate 6).

Thus, we may conclude that the Jebel Garian is fairly typical of semi-arid mountain area. Its uniqueness is, however, shown in the evolution of the landforms and the extensive areas of basalt and phonolite. The forces of erosion that have led to the emergence of the present landforms are still active in the Jebel. The three stages of arid erosion - youth, maturity and age - are all present.

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## CHAPTER IV

### WATER RESOURCES

Underground water conditions in the region of the Jebel Garian are unlike those in the Tripolitanian Jefara which is the richest region in the country. This is due to the geological formation of both the Jefara Plain and the Garian Mountain. The former is composed of Tertiary and Quaternary sediments which dip gently northwards, most of them being continental deposits of aeolian sands, alluvium, gravels, conglomerates and crusts. <sup>(1)</sup>

Lying beneath the marine deposits of the Miocene age are further continental deposits. The sandy plain of the north is made up of Quaternary Gefarico series and the Inner Jefara in the south is composed mainly of Trias. This is the most important part of the Jefara since the Jebel Wadis: Wadi Mejenin, Wadi Héra, Wadi Zaret, Wadi Arbaa etc., flow down from the Jebel to vanish into this zone and much of the water infiltrates into the Triassic substratum. This zone forms the catchment area of the Jebel Wadis (Fig. 20).

The Wadi Mejenin has a catchment area in the Jebel of 650 sq. kilometres which receive an average rainfall of 300 mms. The annual amount of rain falling on the catchment area is 195,000,000 M<sup>3</sup>, of which 13,000,000 is lost to infiltration (6.7%), 19,500,000 flows from the Jebel and the rest evaporates. The Mejenin has the largest discharge of any of the Wadis flowing from the Jebel. <sup>(2)</sup>

The water flowing in the Mejenin from the Jebel is composed approximately of 2 floods of 6 million m<sup>3</sup> lasting 3 days; 1 flood of 4 million m<sup>3</sup> lasting 48 hours, and 1 flood of 2 million m<sup>3</sup>



lasting 24 hours. Dr. Magazzini has listed the recent rainfalls which have resulted in floods in the environs of Tripoli as follows:

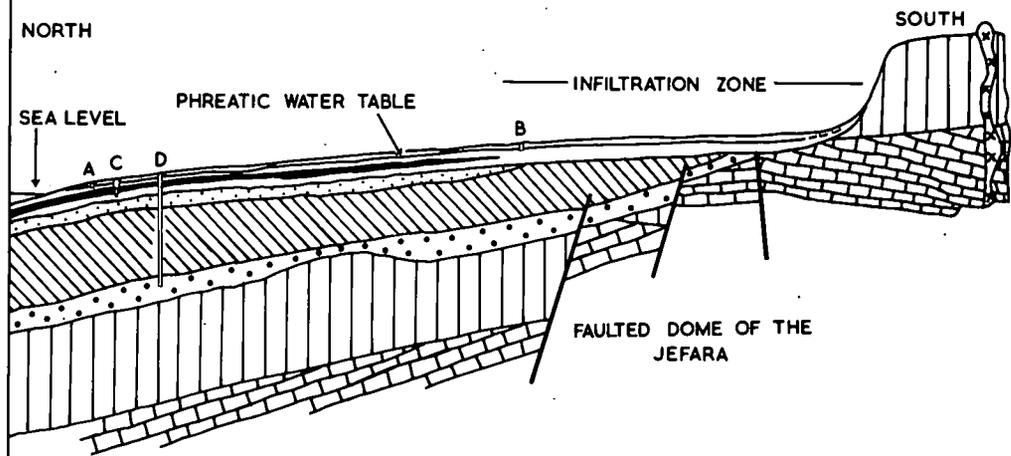
Rainfall and flooding

Locality	Dec. 1938	Dec. 1945	26-29 Apr. 1955	26-29 Dec. 1955	12-16 May 1956
Garian	81 mms.(10 days)	100 mms.(6d)	41 mms.	90 mms.	33 mms.
Tarhuna	90 mms.(7 days)	60 mms.(8d)	55 mms.	93 mms.	30 mms.

As regards the Jefara, most of the underground water and runoff of the Jebel accumulates in the structures mentioned above.

The Jebel Garian, fundamentally, is composed of Secondary sediments: Triassic, Jurassic and Cretaceous. They dip greatly northwards and gently southwards, most of them being continental deposits of limestone and sandstone. The depth of the water-table increases towards the escarpment, but the inclination of the water-table is not uniform, being steep near the Jebel and almost flat near the coast (Fig. 21 ). Thus the water-table is very deep and rises to 500 metres above sea-level, compared with the north-east of Azizia where the water-table rises to 85 metres, or in the west where it rises to 95 metres, and in the Gattis area the first water-table rises to over 100 metres above sea-level. As a consequence, the water-table exists too far from the surfaces of the Jebel Plateaux, and the foot of the scarp is the only zone which contains major springs. Moreover, underground water exists at the bottom of the wadis, where the water-table is near the surface. The existence of such water relies entirely on the amount of rainfall which falls annually. In general terms, therefore, the water resources of the Jebel may be classified as

FIG. 21. AQUIFERS BENEATH THE JEFARA PLAIN  
 AFTER DESIO - CHIESA - VIALI - LIPPARINI - ARCHAMBAULT



- QUATERNARY & RECENT MATERIAL -  
AEOLIAN SANDS - ALLUVIUM - FANS  
CONCRETIONARY LAYERS
- TIRRENIAN CLAY LAYER
- MIOCENE LIMESTONE - TORTONIAN
- MIOCENE CLAYS & MARLS  
HELVETIAN
- MIOCENE SANDS GRAVELS  
SANDSTONES LANGHIAN
- CRETACEOUS
- TRIASSIC
- DYKES & INTRUSIONS

FIRST & SECOND  
AQUIFERS

IMPERVIOUS  
SEPARATES THE ABOVE

MINOR AQUIFER

IMPERVIOUS CAP

CHIEF ARTESIAN  
AQUIFER

?

?

TYPES OF WELLS

A. LITTORAL PHREATIC

B. INNER JEFARAN

C. DEEP QUATERNARY

D. ARTESIAN

follows:-

Under-ground water :- Springs, Wells and Cisterns.

### SPRINGS

The major springs which exist in the Jebel are located at the foot of the Jebel such as Rabta el Garbia and Rabta el Shargia, or are sited at the bottom of the minor wadis, as for instance, Ain Turk, Ain Mgar, Ain Tobi, Ain Maimuna and Ain Sdendu. Figure 22 shows their distribution.

1. Ain Turk is situated in the Wadi Tegassat to the West of Garian. The capacity of this spring is 120-150 m<sup>3</sup>/hr. and is utilized only for domestic purposes by the urban people of the Garian and Tegassat villages. (Plate 7)
2. Ain Maimuna lies to the north-east of Garian about one kilometre and a half at the foot of the scarp. This spring is exploited only by the eastern section of the town. In other words the capacity of the spring is low; it varies between 10-15 m<sup>3</sup>/hr.
3. Ain Tobi is situated to the east of Garian in the Wadi Tobi (tributary of Wadi Guassem). The water of this spring is limited (10-15 m<sup>3</sup>/hr.).
4. Ain Sdendu is located in the western section of the Mudiriyat al Guasem. The capacity of this spring is somewhat limited and is 20-25 m<sup>3</sup>/hr. Therefore the exploitation of this spring is made in conjunction with the other major springs.
5. Ain Mgar lies about seven kilometres to the west of Garian. This spring is sited at the bottom of the wadi floor of Mgar

(tributary of Wadi Arbaa). This spring is utilized only for the domestic requirements of Tigrinna village and the ex-Italian farms. It has a capacity of 150-200 m<sup>3</sup>/hr. which is considered the highest of all the Jebel springs. Its water is distributed through certain pipes in order to fulfil the requirements of the village and the Berber tribes.

The Italian government built a reservoir at these five springs in order to retain the water and distribute it through channels which extend for a considerable distance. The local inhabitants used to irrigate their own gardens, but the Italian government prevented the exploitation of springs since the reservoirs were built.

6. Ain Rabta el Garbia is located at the foot of the Jebel and is regarded as the most important spring in the region. The water of this spring is exploited by the Arabised Berber cultivators for both irrigation and domestic use. The capacity of the spring is 200-250 m<sup>3</sup>/hr. The water, however, is of inferior quality and is inclined to be brackish, being harmful to certain sensitive crops such as green pepper and tomatoes, but it is suitable for date-palms.

7. Ain Rabta el Shargia is less important than the previous spring, since its water capacity is limited, being estimated at 100-150 m<sup>3</sup>/hr. The Arabised Berber cultivators who are settling in these oases exploit its water for both irrigation and domestic requirements. The quality of the water is similar to that of Ain Rabta el Garbia.

8. Ain Bu Ayyad is situated in the wadi floor of Torshin (tributary of Wadi Arbaa). The Berber gardeners exploit its water for irrigating the minor terraces of the wadi.

9. Ain Dannun is located in the Wadi Arbaa and the capacity of this spring is less than Ain Bu Ayyad. In the same manner Beber gardeners exploit its water for irrigation and domestic use.

Moreover there are other numerous springs existing in Asabaa as for instance Ain Misca (in Wadi Misca), Crema (in Wadi Creama) and Ain Hasnun etc.. Ain Bu Gheilan is very important for the local tribes of al Guasem and it is utilized by the Police Station at Bu Gheilan (Plate 8). In Al Orban there are several springs located mainly on the wadi floor.

It must be borne in mind that the capacities of these springs differ from one another and they depend on the reliability of run-off and precipitation. Their capacity is high during the winter, medium in autumn and poor throughout the summer. No reservoirs have been built to maintain or increase the water-springs. Therefore there is a decline in the amount owing to the full consumption by the inhabitants. The responsible authorities in the Tripolitanian Administration are going to repair and improve the maximum capacity of the springs.

#### WELLS

The wells of the Jebel are simply holes, dug, bored or drilled in the ground to a considerable depth at which water bearing permeable formations or fissured rocks are encountered. They are mostly shallow and dry at certain seasons, unless they

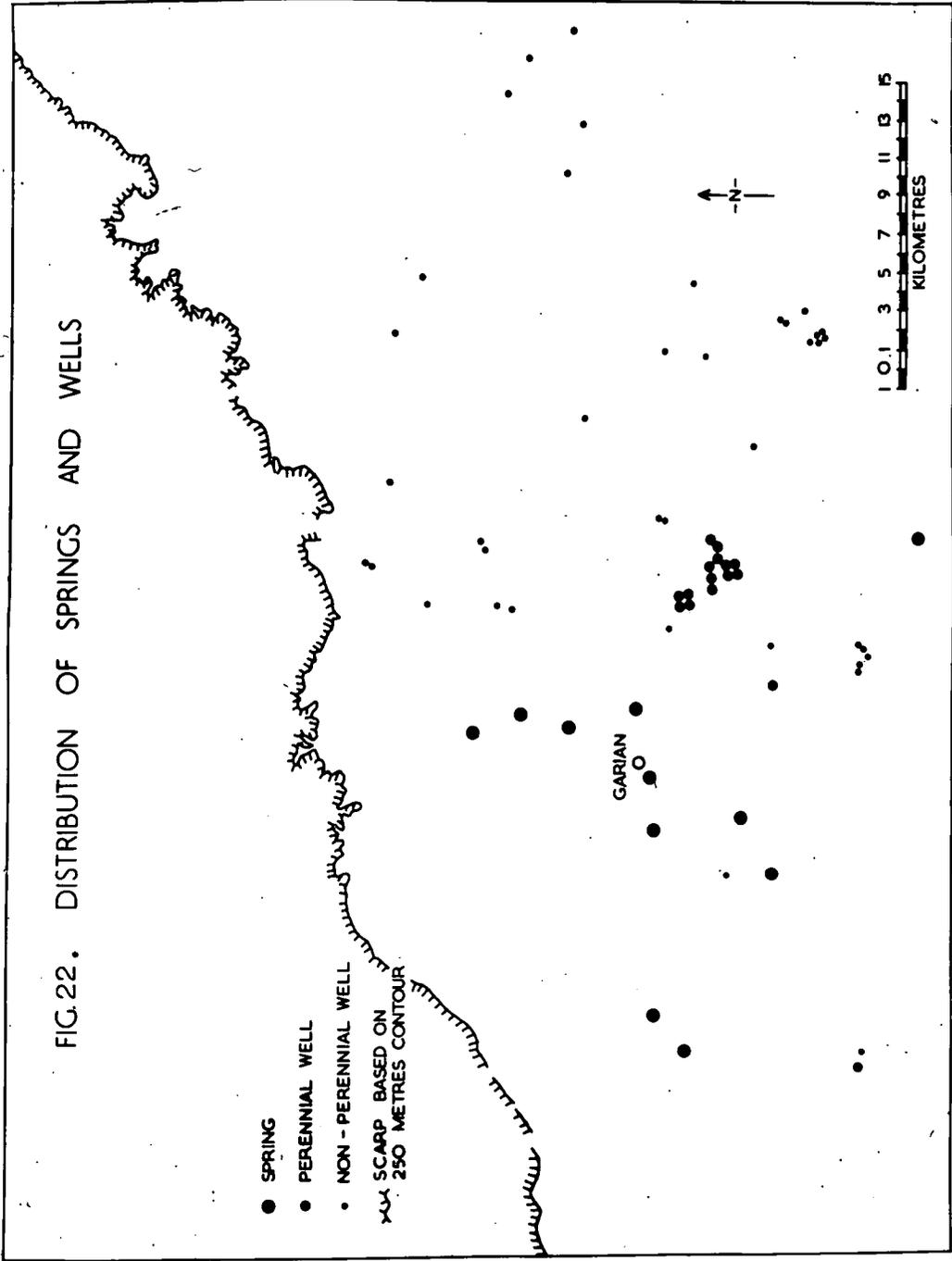
tap the zone of permanent saturation. Ground water percolates into the bottom of the well, and rises to a level that depends on the head pressure behind it. Pumping or lifting may be necessary to bring water to the surface. However, the depth of the Jebel wells varies from zone to zone, the average being ten metres in depth. The following table shows the depth of selected wells.

<u>Locality</u>	<u>Dept. in m.</u>	<u>Water in m.</u>
BIR EL UAAR	10.50	1.50
" Gau	6.	1.30
" Zenatui	20.	2.20
" Hammam	8.50	1.50
" Kmashat	5.	2.30
" Yaaghib	4.	2.
" Crema	3.50	1.

The wells are located to the bottom of the wadis, where the water-table is near to the surface. There are, for example, four permanent wells in Kmashat and ten wells in Slahat. In Wadi Arbaa, there is only one permanent well. Moreover, there are also numerous wells in both Asabaa and Orban (see fig. 22 ).

The main exploitation of these wells differs from place to place. In both Slahat and Kmashat, the sedentary people utilize water mainly for irrigation. The remaining wells serve the domestic requirements of the people and the needs of live-stock. However, those wells which exist in both Asabaa and Orban determine the settlement of the nomads and semi-nomads of this zone of the Jebel. Water here plays an important role, especially during the summer months when there is great movement

FIG. 22. DISTRIBUTION OF SPRINGS AND WELLS



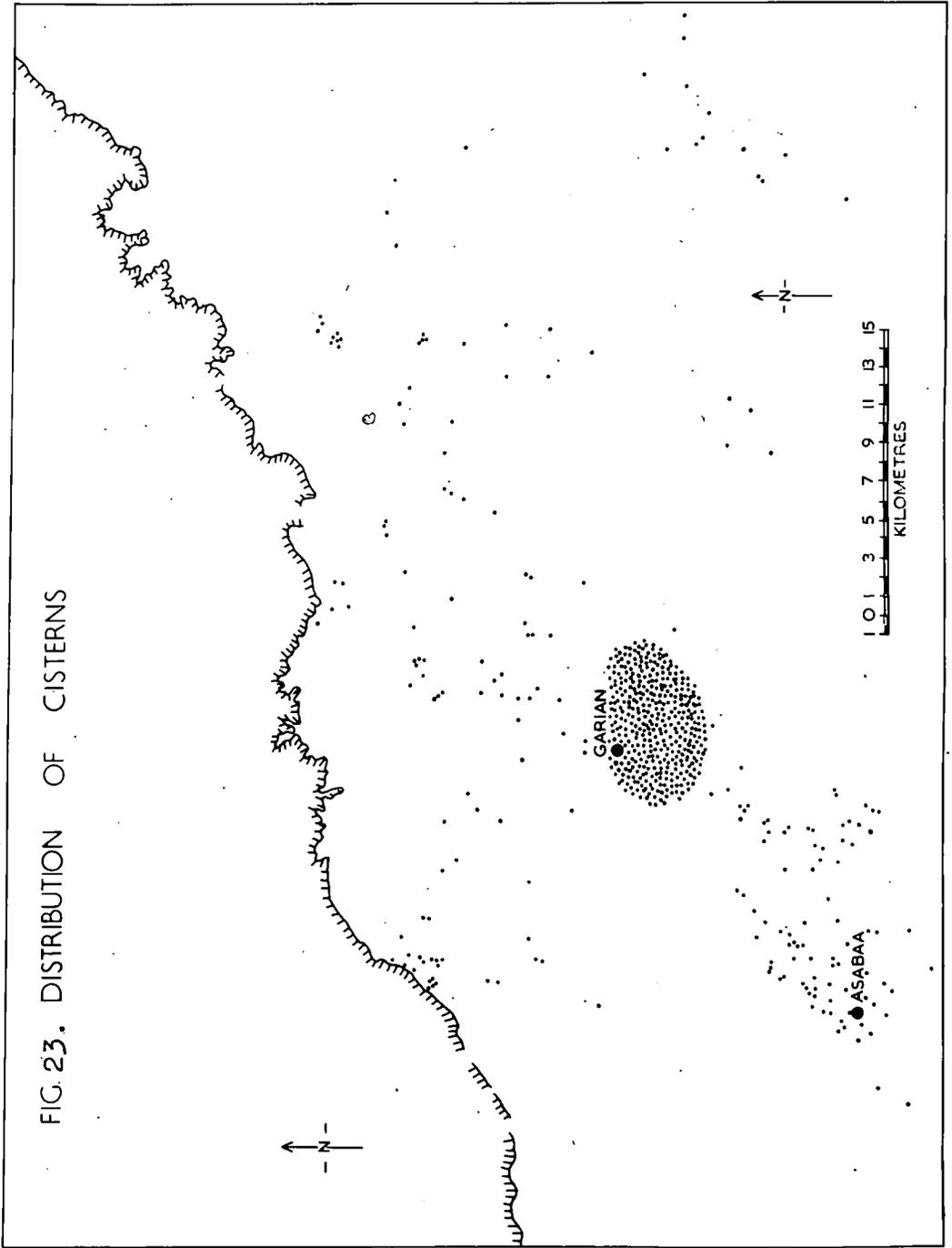
of the people from Ghibla to the north of the Jebel.

The total number of the Jebel wells is fifty, and of them fifteen are perennial. The Tripolitanian Department of Agriculture plans to repair those wells in the near future, having already repaired 28 wells in the period between 1958-60. Well reparation is of great importance to both the sedentary and nomadic peoples, in order to extend agricultural lands and maintain livestock in the Jebel, particularly through the years of drought.

### CISTERNS

Cisterns are the most important resource for the domestic requirements of both the semi-nomadic and sedentary peoples of the region. They are formed on a large scale throughout the whole of the Jebel with special concentration in the ex-Italian farms and Asabaa and Gattis (Fig. 23). Sometimes each tribe and each family has a cistern. In general, cisterns are made near the rocky slopes of limestone or hard sandstone where absorption of rainfall by the soil is low, and a large proportion runs off. This water is collected by means of small earth or stone walls and is run into sedimentation pits and on to an underground cistern.<sup>(5)</sup> The large cisterns are mainly Roman and are lined with stone masonry, and arched with stone above in tunnel-like shape, many yards long and sometimes four yards wide. The depth is 8 to 10 feet and sometimes more. The Jebel Berber cisterns used today are not as large as the ancient Roman ones. They consist generally of a small hole at the top

FIG. 23. DISTRIBUTION OF CISTERNS



which can be closed and locked, leading to a cavity which is laboriously excavated by hand, and lime or some other substance is used to make the walls waterproof. Little evaporation occurs and the water remains clear and cool. The A.T.I. (Azienda Tabacchi Italiani) built a cistern for each ex-Italian farm house which can provide water for the family. The water is collected from the rain which falls on the flat roofs of the houses and is piped into storage cisterns for the use of the family and for the irrigation of vegetables and flowers. The total number built by the Italian Agency is 352. Moreover, there are several large cisterns in Tigrinna for the houses of the civil servants.

There are a tremendous number of ancient Roman cisterns still in existence throughout the whole of the Jebel. Some of them are still used by the inhabitants but many of them are ruined through neglect. They can be used again if they are repaired and the reconstruction of these old cisterns would not be difficult as modern excavation machinery might lower the cost, to such an extent that the construction of new ones would be made unprofitable. It is worthy of note that if one inch of rainfall is collected as run-off from two hectares of land, it is sufficient to fill a cistern containing one hundred thousand gallons (500 cubic metres).

As a result of the advantages of cisterns for the Jebel people, the Agricultural Department reconstructed from 1958-60 one hundred and twelve cisterns. Their distribution is as follows:-

<u>MUDIRIYAT</u>	<u>NUMBER OF REPAIRED CISTERNS</u>
Beni Daud	25
Beni Nser	15
Beni Khalifa	16
Al Guesem	37
Al Asabaa	11
Al Orban	11
	<u>115</u> Total

The cistern, therefore, has great value in extending land development and encouraging the settlement of semi-nomads. The cistern can provide water for most of the year for both man and animals.

Although cisterns have many advantages they have a number of serious disadvantages, some of which are mentioned below.

- (a) In the case of cisterns needing repairs, cleaning, etc., they have to be emptied and it is not possible in the erratic climate to anticipate exactly when the rainfall will come to fill them again.
- (b) Cisterns depend on heavy rains and adequate run-off to fill them. The rainfall in the Jebel is not constant.
- (c) Careful control is required to ensure that the water is used sparingly.
- (d) The water supply from cisterns is more subject to the influence of drought than from wells.

One may come to the conclusion that the hydrological factor is very important in the Jebel since the agricultural activity, livestock and man rely entirely on it. In order to increase

the water resources, these suggestions should be carried out:-

1. Repairing of springs existing at the foot of the Jebel and other springs which are found in Asabaa and Orban. On the other hand it is possible to increase the capacity of the present permanent ones.
2. Wells must also be repaired in order to increase the capacity of the water. The Agricultural Department has succeeded in repairing some of them.
3. It is possible to construct new cisterns and reservoirs on the modern methods which retain a large amount of water during the whole year. The ex-Italian Agency has successfully built more than 350 cisterns. At the same time the government must carry out its plan of repairing the old ones.
4. The water problem is regarded as very serious and its solution would help towards solving other problems, such as those which the semi-nomadic people create by their constant moving around, in search for water supplies.
5. Improvement of water conditions would subsequently lead to improved conditions of livestock, particularly during the summer months and the years of drought.

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## CHAPTER V.

### SOIL

Soil development is determined usually by conditions of temperature and moisture, so that soil types show a close relation to climate in their wider distributions. But the detailed characteristics of soil in Libya are due to the underlying bed-rock, the drainage conditions and the minute differences of slope. Therefore, there is a very close relationship between the surface of the land and the soil that develops on it.

The Jebel Garian is formed by a series of arenaceous and argillaceous marls, soft and crystalline limestone, dolomites, sandstones, silts and clays, of both Cretaceous and Jurassic age. Over extensive areas these formations are masked by considerable deposits of Quaternary age (Pleistocene). Extensive basaltic phonolites also occur east of the Garian parallel. Thus the sub-soil of the Jebel is derived from these geological variations of the Jebel rocks. These soils have been presumably transported, for their materials have been brought to their present position by water or wind. Furthermore, the soil development has taken place under the influence of a continental semi-arid climate, with wide daily and annual ranges in temperatures, and restriction of precipitation to the cooler months. Wind movement is higher <sup>from</sup> April to June when numerous dust storms cause soil erosion and drift formations. Natural vegetation in such a semi-arid region is sparse and consists of plants that mature quickly after the winter rains, as for instance esparto. In most of the southern zone

of the Jebel where there is no irrigation, the natural vegetation cover resembles that of the desert grasses, as for example *Rosmarinus Officinalis*, *Calycotome Intermediare*, etc. The more plentiful types are found in the more humid zone to the north of the Jebel. However, the vegetation cover of the Jebel is not merely sparse because of climatic conditions but also because of the varieties of soil.

The soils of the Jebel Garian have resulted primarily from physical, and to a less extent, from chemical weathering.<sup>(1)</sup> They generally conform to the arid steppe type. Most of the cultivated land of the Jebel may be classified as brown Pedocalic Regosols. Alluvial soil occurs along the wadis as for example Wadi el Guasem and the bottom lands of the Jebel (Gattis). Lithosols soils are found at the foot of the Jebel (Rabtas). The so-called 'intermediate type' soils are composed partly of alluvial and aeolian deposits. The primary elements are aeolian sands from the extreme Ghibla in the south, and sands of marine origin, together with weathered material derived from limestones, sandstones, marls and clays, supplying the secondary elements. Because of physical conditions, these soils show a marked tendency to erosion by wind or water. Both brown regosols and alluvial soils are extensively exploited by the indigenous people for agricultural activity.

Most of the Jebel soils are open free-draining friable with high rates of percolation. The structure is mainly single grain though sometimes it may result in the presence of some fragile

granules<sup>(2)</sup>. There is no salinity problem over the Jebel, but it does exist in Rabtás where the farmers use irrigation from major springs. Hence, there is the hazard of a salinity problem developing in time and affecting the crops and vegetables.

Organic matter is very deficient and consequently the nitrogen content and the water capacity is poor.<sup>(3)</sup> The available nutrient status shows potassium to be adequate and phosphorous low (See Table 1). In general the Jebel soils may be classified into the following seven main soil types.

Brown pedocalic regosols. This soil is called locally Ard Hamra. It is described as a fine, grey-brown, sandy soil with little clay and silt. The soil is usually 10 metres thick, low in organic matter but not so low as in the sandy soils, and exhibiting some degree of cohesion. The grey brown colour is the result of the presence of alluvial layers of calcium carbonate occurring at variable depths. It occupies the vast plateau areas of the Jebel with the exception of the large wadis. It is typically and extensively developed in the Jebel Garian and the Jebel Tarhuma.

Ard Tena These are characterised by a greater mixture of local as opposed to aeolian materials, large quantities of the marly limestone being mixed with the sand. It is less red, being found in the rocky areas as terrains that have been slightly displaced or as colluvials. Thus the soil has greater compactness with a higher lime and clay content.<sup>(3)</sup> It is very often

shallow, occupying the slopes of the higher elevations with rocky sub-soil, but also found in the greater wadis, eg. Wadi Zaret, Wadi Arbaa, etc., and where other wadis have been incised. The "ard ten" is very suitable for cultivation and most of the agricultural activities are restricted to this zone of the very fertile soil.

Moreover, there is also in the Jebel, mainly in Al Guasem, soil derived from volcanic parent rocks. This variety of soil is also called ten but there is an important difference as this is harder and less easily eroded.

It is difficult to distinguish between soil and subsoil in the Jebel. The Quaternary is often thick and the indigenous people in their cultivation recognise no difference between them. The natural rocky sub-soil is found at a depth which varies according to the thickness of Quaternary and thus varies from a few metres to over ten.

The depth of the soil varies from a maximum around the cultivated areas to a discontinuous cover over the southern zone of the Jebel. The depth of sub-soil is deep, the sand is loose, porous, permeable, aerated with a low capillarity being easily worked and enabling root penetration.

There is a great similarity between the Jefara and the Jebel soils, as both of them are characterised by:-<sup>(4)</sup>

1. An almost complete absence of large rock grains.
2. A great preponderance of dominantly sandy siliceous materials.
3. An absence of humus and organic remains.
4. Variability of calcium carbonate content from a minimum of 4.8% to 22%.

The variation in proportion between the sand and clay is typical, and calcareous contents are influenced by the parent bed rock.

#### Intermediate types of soil

This soil type has been given this name since it is composed partly of alluvial and partly of aeolian material. It is very similar to the soil found in Southern Tunisia, and Despois<sup>(5)</sup> maintains that this soil is the nearest to loess in Tripolitania. It is, however, very difficult to define it precisely as previous studies often give a different interpretation, and this has led to some confusion of thought.

Cotha<sup>(6)</sup> gives the most specific description of the Intermediate soil type. It is a fine, grey brown sandy soil with a little clay and limon and it is occasionally covered by small dunes of about one metre in height. It is usually about ten metres thick, low in organic matter (but not so impoverished as the sandy soils) and it has some measure of cohesion. There is not a true profile, but there is a hint of stratification. The grey to grey-brown colour is due to the presence of alluvial layers of calcium carbonate at varying depths. The slightly stratified appearance of the profile also reflects the nature of the parent material which is derived from three sources:-

- (a) Breakdown "in situ" of the Quaternary Gefarico series.
- (b) Important aeolian material, either sand from the extreme south or wind-sorted limon from the alluvial lands in northern part of the Jebel.

(c) Alluvial material of varying particle size from sand to clay which is occasionally spread out by the wadis. The present material has some form of stratification before the pedogenic processes start to operate. (7)

Most of these soils are found to the north and the east of the Gattis plain.

#### Alluvial soils

The alluvial soil resulted from the deposition of material, coarse and fine, eroded from the Jebel hills. The soils so formed may vary in texture from coarse sand and gravels at the foot of the Jebel to heavier soils in the basin and depression of Gattis land, where flooding occurs after the winter. When the wadis change their course in Gattis from year to year, they can give rise to varieties of soil material deposited in particular localities. These soils are considered the most fertile in Tripolitania owing to their derivation from the calcareous beds of the Jebel. The heaviest soils are found towards the limits of the flood plain, where the suspension load of the flow has been deposited, at some distance from the wadi bed. These soils are very rich in limon, and this material is only a few centimetres thick and may be found overlying any other textural class of soil. It is characteristically heavier than other alluvial deposits. Its mechanical composition is:-

Sand	5 - 10%
Silt	60%
Clay up to	30%

Drainage difficulties can be overcome by incorporating limon with the lighter subsoil with which it is normally found.

The alluvial soils of the Jebel are used by the Berber and Arab cultivators for the production of wheat and barley. In these areas most of the Gattis land is ploughed about once every three years, although a little may be ploughed yearly. Land in general, is left fallow after it has been cropped and no clean summer fallow is practised. This allows the wind to revitalize the soil deposits of aeolian materials.

#### Soils of the Piedmonts

These soils can be described as colluvial soils and they are similar to the alluvial soils. They are generally developed in a series of long narrow gravel ridges which are distinctive in form and constitute the southern boundary of the interior plain of the Jefara.

#### Lithosols

These azonal soils consist of fans of stony material and gravels brought down when the neighbouring wadis are in spate (flash floods). In the course of time fusion of these fan deposits takes place and this way gives rise to a belt of detritus lying at the foot of the Jebel escarpment. Falling scree from the heights of the rock face makes its contribution to this material. These soils are generally subject to erosion by water and the soils which may develop are very immature. They are unsuitable for agriculture.

7. Eroded soils of the Jebel Hills

Most of these hills are so eroded and bare that even soil material is scarce. The parent materials of limestones, sandstones and arenaceous marls and shales give rise to small pockets of coarse shallow soils on the denuded slopes; even these are immature and therefore Azonal. Caswell classifies this type of land as non-arable steep, rough, broken or badly eroded, with soils coarse in texture and very shallow. Soils of this category have no agricultural value. (8)

SOILS IN RELATION TO AGRICULTURE

Of the soils and soil material described already only types one, two, three and four are exploited for agriculture. The agricultural significance of these depend on physical characteristics, organic content, salt content, nutrient status and chemical availability at existing pH values.

Table 1. Soil Sample Analysis - Garian.

Chemical analysis

	pH			<u>% Carbon</u>	<u>% Organic</u>	<u>% loss on Ignition</u>
1. Guasem	8.5	High	High	1.3	2.2	2.8
2. Beni Dand	8.6	Low	High	0.6	1.0	2.8
3. Beni Nser	8.7	V.High	High	1.1	1.9	3.4
4. Khalifa	8.6	Medium	High	0.7	1.2	3.2
5. Al Asabaa	8.6	V.Low	M.High	0.6	1.0	2.9
6. Al Orban 1.	9.15	M.High	High	0.7	1.2	13.7
7. Al Orban 2.	8.6	Medium	M.High	0.4	0.7	2.0

Mechanical analysis

	<u>Coarse sand</u>	<u>Fine sand</u>	<u>Silt</u>	<u>Clay</u>	<u>Textural Classification</u>
1. Guasem	0.4	81.2	10.4	8.0	Loamy sand
2. Beni Dand	0.5	76.0	11.1	12.4	"
3. Beni Nser	2.7	72.3	12.5	12.5	"
4. Khalifa	0.4	79.2	10.3	10.3	"
5. Al Asabaa	0.2	86.5	5.1	8.2	"
6. Al Orban 1.	24.5	42.7	20.3	12.5	"
7. Al Orban 2.	0.1	89.5	4.2	6.2	"

PHYSICAL

The results of the mechanical analysis of soil samples are shown in Table (1). Samples one, five and seven are from the intermediate soil type, and samples two, three and six are from the Ard Ten; whilst sample four is transitional. Fine sand predominates in all samples whilst both the clay and the silt content is highest in Ard Ten. By plotting the results of mechanical analysis on the triangular diagram the texture of all the soils was found to be loamy sand. The soils have a weak crumb structure with some clods which readily break down to single grains. Sometimes the clods are held together with matted roots.

As a result of their structure, it is probable that most of the soils would have a satisfactory infiltration rate whilst capillarity would be low.

NUTRIENT STATUS.

Some estimate of the nutrient status of soil may be given by a determination of the following:-

- (a) soil reaction
- (b) organic matter content
- (c) nitrogen content
- (d) available potassium and phosphorus
- (e) chemical availability

(a) Soil Reaction. The soil reaction is given by the pH value. Table 1 shows the pH value of the 7 samples. All the pH values are high but a value of 8.8 is exceeded in only one case. As this sample was taken from soil excavated from the site of a cistern it cannot be concluded to be typical. The soils are thus alkaline but not to a degree where their use in agriculture is precluded.

(b) Organic Content. Studies in the Jefara have shown that the organic content of Libyan soils is low ( 8 ). The dominant red or yellow colour of the soil is indicative of a low humus content. In the Jefara, figures for organic matter varied from 0.3% for sandy soils to 2.5% for clays. The organic matter content may be expected to be higher in the Jebel where the vegetation cover is more continuous, though results here recorded show that it is still low.

The organic matter values have been calculated from the carbon content by the use of a conversion factor (1.724).<sup>(9)</sup> Figures for loss on ignition are also presented. The discrepancy between these two different estimates of organic matter is noteworthy, and is probably the result of chemical dissociation, although, after ignition, the carbonates were reformed with

ammonium carbonate. The greatest discrepancy is with the Orban 1 sample and it is interesting that with this sample the recovery during mechanical analysis was only 85.7 per cent indicating a high content of soluble salts.

(c) Nitrogen Content. In virgin soils the presence of nitrogen is the result of the accumulation of humus and its content can be maintained by the application of manures or fertilizers or by the cultivation of nitrogen-fixing legumes. On some intermediate or alluvial soils of the Jefara, the nitrogen content has been shown to be about 0.1%. Similar figures could be expected in the Jebel soils.

(d) Available Potassium and Phosphorus. The available phosphorous content is generally high in the samples. In the Jefara, Caswell ( 10 ) found that the absolute phosphorus content varied from 0.01% to 0.007% compared with the world figure of 0.2%. Thus, though the total phosphorus content may be low, it appears that it is in a form readily available to the plants, and it is probable that the phosphorus would not be a limiting factor to plant growth.

In arid zones it has been found ( 11 ) that the potassium content of the soils varies between 0.15% for sands and 4% for clays. The results for available potassium with the samples under discussion show marked variations, some of the soils being very low (e.g. samples from Asabaa and Beni Daud) whereas others are by high (Beni Nser). This variation could not be associated with differences in soil type.

(e) Chemical Availability. Values for soil reaction are important in assessing the availability of soil nutrients. A soil with a high pH reduces the nutrients available to the plant. This is especially the case with phosphorous and trace elements. Indeed, the low content of nutrients associated with the high pH values may lead to deficiency diseases in the Jebel.

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## CHAPTER VI

### VEGETATION AND AFFORESTATION

Historical geographers are still undecided as to the exact nature of prehistoric vegetation in the region of the Jebel Garian. In the fifth century B.C. Herodotus described in his "History" the luxuriant vegetation which clothed the slopes of the Jebel, inhabited at that time by numerous wild animals.<sup>(1)</sup>

Existing sources refer to the following species prevalent in the above region at the dawn of recorded history:-

1. *Olea Europa* (Olive Tree)
2. *Ceratonia Siliqua* (Carob Tree)
3. *Pistacea Atlantica*.
4. *Pislicacea Lentiscus*.
5. *Zizuphus Lotus*.
6. *Rhus Oxyacantha*.
7. Tamarisk species.
8. *Rosmanus Officinalis*.
9. *Calycotome Intermediare*.
10. *Thymus Capitatus*.
11. *Cistrus Salvifolius*.
12. *Genista Capitellata*.
13. *Peripoca Levigata*.
14. *Lycium Europeum*.
15. *Stipa Tenacissima*.
16. Esparto.

Most of these species flourish in arid conditions. Certain types of plant, however, require more moisture than others, as for example the Tamarisk species. Tamarisk, although it has a certain commercial value on account of its fuel, oil, resin and tanning properties, owes its greatest value to its ability to survive in arid conditions, while at the same time affording shelter from wind and sun. *Pistacea Atlantica*<sup>(2)</sup> grows into a hard wood tree twelve to twenty feet in height with dense foliage. It is found in some of the rockiest places in the Jebel and also in dry Wadis such as Wadi el Hamman (Plate 9). Historical evidence indicates that this tree was grown for its oil production qualities. In addition to its commercial value it was valuable for its shade. *Acacia Tortilis* has shown the greatest capacity for generation among the surviving indigenous trees.

*Zizphus Lotus* is a tree like plant of small vertical dimensions but of extensive length and breadth. It varies in size from a small bush to a ground cover of over 20 square metres. It resembles a large green mound on the landscape.

The *Zizphus Lotus* is important because it indicates zones of either former arboriculture or potential arboriculture. Both Lang<sup>(3)</sup> and Pampanni<sup>(4)</sup> are agreed on this aspect of the *Zizphus Lotus*. This tree is widely distributed in the Jebel. In fact, there are few zones where it cannot be observed. It is found principally in the great wadi valleys of northern Garian particularly in the Wadi Gan, Wadi Arbaa and Wadi Zaret. In these areas,

it is very dense. It is also found sparsely in the southern part of the Jebel.

The *Stipa tenacissima* is a perennial plant with numerous but bunched roots.<sup>(5)</sup> It is generally 1-2 metres high with numerous filioform blades which resemble feather-grass. It flourishes in the winter, autumn and spring but sheds most of its leaves in the summer. It prefers more humid sites so that it is most often found in wadi bottoms and on north-facing slopes. (Plate 10).

Its root systems enables it to collect and hold run-off water which the tap roots can later absorb. Its blades form the basis of Esparto collecting but the local population pull the plant from its roots so that it is beginning to disappear from some areas. It is not confused with *Stipa Lagascae*, which has no economic value. Yet overharvesting and grazing have caused a decline in the yield of Esparto, and in consequence the land of the Jebel continues to lose the finest natural cover which can protect the soil from erosion. If the Tripolitanian Government does not enact laws to protect this plant, there will be a serious decline in the number of this species which will, in the end, affect soil structure.

The remaining species still survive throughout the region except in specific areas which have been utilized for agricultural activity. The land here still maintains its vegetation cover, but the practices of semi-nomadic and nomadic peoples (shifting cultivation and overgrazing) have affected to a great extent

vegetational growth. In addition, people have felled trees for fuel which has resulted in the destruction of plants in the mountainous regions. This phenomenon, however, commenced very early on in the region, right from the first appearance of the Libyan people, and destruction of woodland areas has continued gradually ever since. Moreover the Carthaginians and the Romans cleared large areas of forest in order to utilize the land for the cultivation of olives, figs, grapes and cereals. Grazing has been an important factor in the destruction of natural growth. Although the Romans cleared the forests of the Jebel for agricultural purposes, they encouraged forestry in many areas by means of soil conservation, and by building dams and terraces for fruit trees. As a result certain species of tree, especially those whose wood could be utilized for construction or for fuel are now extinct, such as the Juniper. The Romans did not pursue the matter of forestry with scientific purpose because man, until recent times, thought that forests were natural phenomena which would remain unmaintained, although forest land is one of the main resources of life (grazing cultivation and construction).

At the beginning of and during the Arab occupation, both Berbers and Arabs destroyed the vegetational cover by practising shifting cultivation and animal grazing. The Turks attempted to enact a forest law which would protect the natural forest but this was not successful owing to various factors, mainly land rights and the usefulness of the forest for fuel, and other personal

requirements, which people in the Jebel practised. Therefore one may assume that the Turks did nothing to protect the Natural Vegetation of the Jebel.

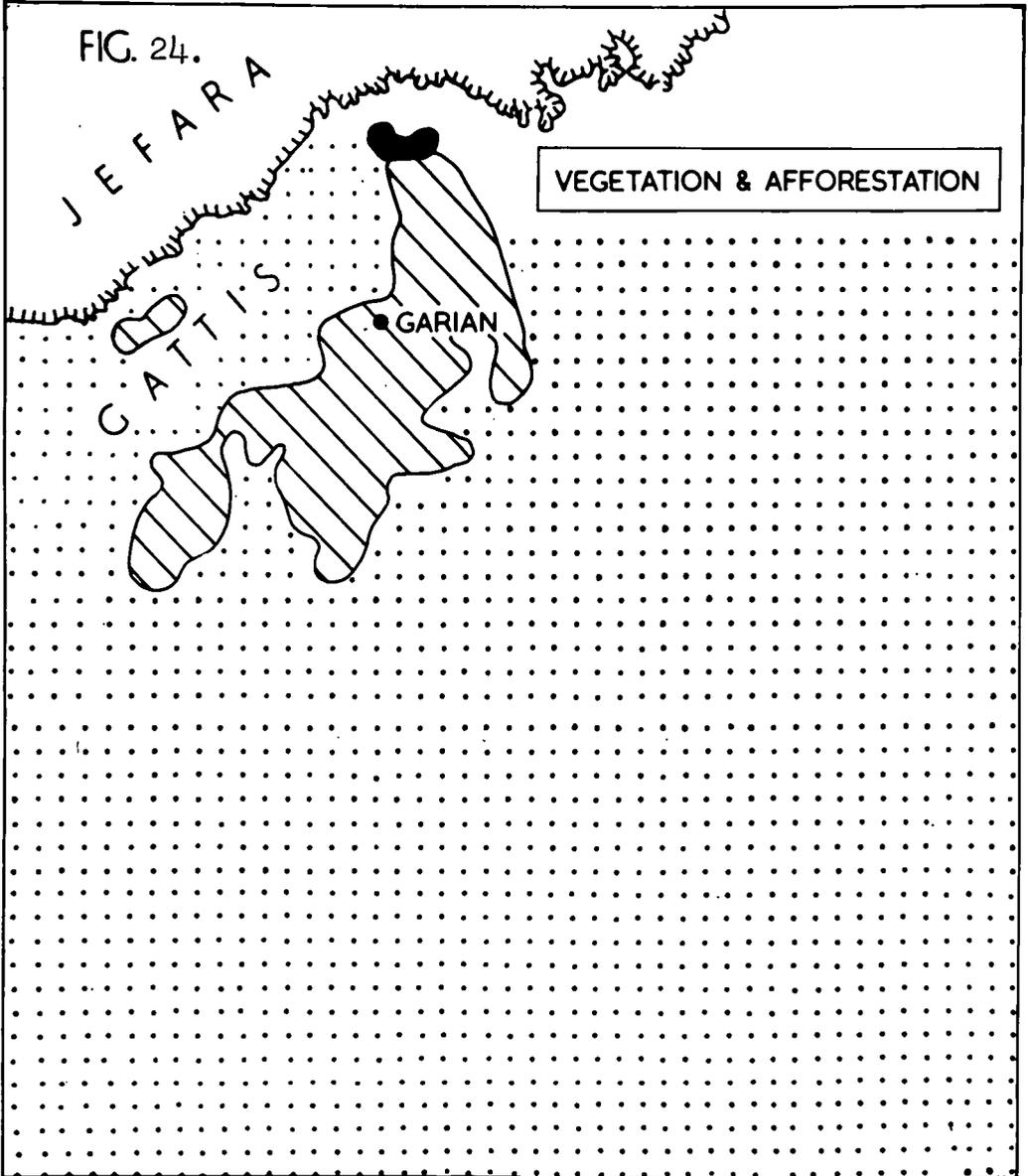
With the Italian Occupation began the protection of natural forest and vegetation. Several laws were enacted to preserve the above-mentioned trees with some purpose. During the last twenty years of the Italian occupation this legislation was effective and little damage occurred to the natural vegetation. The Italians initiated the afforestation of the Jebel at Bu Gheilan, presumably with conifers, e.g. Pine. There are many indications confirmed by the conservator of forests in 1952 of work in this field, yet he only found a few holes which had been used for Pine, but there remained nothing of this on the slopes of the mountains, except at the foot of Bu Gheilan where the Italians had established a Police Station in the vicinity of the Bu Gheilan Spring. The Italians, however, had initiated their programme during the latter part of their occupation (roughly 1938 onward) and furthermore there was considerable negligence on the part of the authorities in this matter during the post war period. In the same way, during the British Military Occupation (1943-1951) nothing was achieved as regards afforestation in the whole mountain area. Serious afforestation on the other hand was initiated at Bu Gheilan in 1953 by the Forest Commission, and since that time every year, several hectares of land have been planted with suitable species, namely:- (6)

1. *Pinus Halepensis* (Bot.) Pino d' Aleppo (Italian).
2. *Cupressus sempervirens* (Bot.) exotic to Tripolitania,  
indigenous to Cyrenaica. Cipresso (Italian) Cypress (Eng)
3. *Eucalyptus* species (Exotic) Eucalitti (Italian)
4. *Casuarina cunninghamiana* (Bot.) exotic.
5. Carob trees (Eng.), indigenous, Carrubi (Italian), *Ceratonia  
Silqua* (Bot.)
6. *Acacia Cyanophylla* (Bot.) exotic. *Acacia Australiana* (Italian)
7. *Pinus Pinea* (Bot.) exotic Pino Pinolo (Italian).

These species serve different purposes, as for example the pine which flourishes best in the Jebel region and has a higher timber quality because it can thrive in arid conditions, and in soil of a low moisture content. It is, however, a slow growing species compared with the remainder, and is composed of inflammable material and does not shoot again if damaged or felled. The Aleppo pine can also be planted in the calcareous, rocky areas, and its plantation can be successful on slopes which do not exceed twenty degrees. Thus, all the run-off water is collected in the canals left by sub-soiling and is available there for the young plant, whose roots penetrate into the soil more easily as a result of its having been broken up.

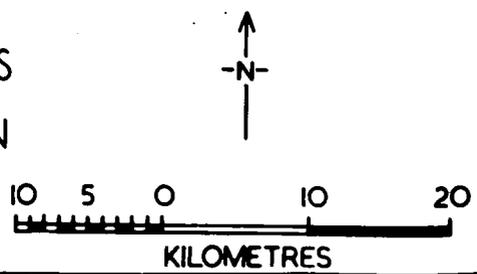
However, trees Nos. 1, 2, 3, 4 and 7 proved successful in the Bu Gheilán area, so they can be used without hesitation. Trees Nos. 3 and 6 proved to be suitable provided that the site is well chosen in advance so that it will not be liable to forest

FIG. 24.



VEGETATION & AFFORESTATION

-  AFFORESTATION
-  AGRICULTURAL AREAS
-  NATURAL VEGETATION
-  SCARP



damage, deep soil etc. Robinia Pseudo acacia (Bot.) is not used at Bu Gheilan, presumably only at the Jebel Garian a long time ago. It is to be recommended for an arid region and can be not only successfully grown at Bu Gheilan but also in the whole of the Jebel.

The Forestry Department started the serious afforestation of Bu Gheilan in 1954 and the numbers of the trees which were planted in 1958 were as follows:-<sup>(7)</sup> (Fig. 24)

1. Pinus Halepensis	16,000
2. Eucalyptus species	2,000
3. Acacia Cyanophylla	1,500
4. Cupressus cumpervireus	1,500
5. Carobs	<u>2,000</u>
Total	<u>23,000</u>

These trees occupied the slopes of Bu Gheilan estimated at forty hectares (Plate 11). Moreover, there are a great number of forest trees existing in each ex-Italian farm in both Beni Dand and Beni Khalifa. They have a total number of 3,620, and the average is ten trees of different species. Most of these trees are found in the vicinity of the farm house, in order to protect the house from the great heat. In Asabaa many trees have been planted and in one farm alone, for example, there are 2,000 trees, and there are a different number of each planted every year. In Beni Khalifa and Al Guasem, there is also afforestation, such as wind breakers in every Berber farm.

Generally speaking the re-afforestation of the Jebel Garian must be carried out by both the Forestry Department and the farmers themselves throughout the mountain in order to conserve the structure of the soil, and thereby avoid soil erosion, which is regarded as a most serious problem. Furthermore, overgrazing and the cutting of trees and scrub vegetation for fuel, leads to the widespread destruction of the natural cover. This phenomenon is apparent in many places over the Jebel, particularly in the western region where there are various barren hills and slopes.

One must therefore conclude that the Provincial Estate in Tripolitania must increase the area of the plantations by increasing the number of trees, not only at Bu Gheilan, but also some afforestation should be carried out in each mudiriyat. People should be encouraged to afforest their own land in the Cabila, and school children should tend one tree each year as a part of the educational syllabus. This would in the end, stimulate an interest in trees, increase the layman's knowledge of their importance, and lay the foundations of future forests. In the same way, a large area of the Jebel should be given to fodder trees in all plantations. These would mitigate the disastrous effects of drought on the numbers and condition of livestock.

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## CHAPTER VII

### POPULATION.

#### HISTORICAL BACKGROUND

The inhabitants of Garian have descended from two types of people, the Berbers and the Arabs. The Berbers who form the greater part of the population are considered the original inhabitants of the Jebel Garian. Ethnically, they are Hamitic and descended from the inhabitants of ancient Egypt and North Africa.<sup>(1)</sup> The earliest Berbers were closely related to the long-headed, brown skinned, dark haired race that had established itself throughout the Mediterranean basin by the end of the old Stone Age (about 10,000 B.C.) Later, those people were joined by fair skinned, blue-eyed immigrants with red or blond hair, whose origin, though presumably European, is a problem still to be solved.

Herodotus in the fifth century B.C. gave us the names and the positions of the chief Tripolitanian tribes.<sup>(2)</sup> The area east and south of the Gulf of Sidra (Greater Syrtes) was occupied by the Nasamanes one of the most powerful Libyan peoples, and the south shore of the Gulf by the Psylli. The Nasamanes' western neighbours were the Macae, whose territory extended as far as the Wadi Caam area. West of the Macae the Jebel was inhabited by the Gindames, the coastal plain by the Lotophagi or Lotus-eaters, followed by the Machlyes who stretched as far as Lake Tritonis (Shott Al Gered). The interior of the country was occupied

by the Garamantes in Fezzan. Later, during the Roman period, from the third century A.D. onwards, there were new names which are obviously those of large tribes: Ifuraces, Austurians, Leuathae. Herodotus describes the Libyan tribes of Tripolitanea and Cyrenaica as milk-drinking and flesh-eating, that is to say nomads. (3)

Later, during the occupations of the Phoenicians, Romans, Vandals and Byzantines, the Berbers generally mixed with the invaders. They were influenced by newer elements, particularly by the Vandals who came from Spain and spread throughout the whole of North Africa.

The Arab invasions of Libya have had little racial influence on the inhabitants of the Jebel Nefusa, especially, the western parts. The foreign influence in the eastern terrains was linguistic more than racial. The peoples of the Jebel particularly in the Jebel Garian have retained their physical characteristics, because they have not favoured intermarriage with the Arabs. There are several reasons for this, including the fact that they believe that the social and economic standards of the Arabs are low as they are either nomads or semi-nomads. Hence, the Arabs settled in specific areas of the Jebel, where grazing land was available, and maintained their own tribal traditions and customs. Those Arabs came in the eleventh century as a result of the great invasions during the Fatimite dynasty.

During the Turkish rule of Libya, some Turkish soldiers inter-

marrried with the Berbers of Garian, and produced a new type of people known as Kologlis. The physical characteristics of this type differed slightly from the Berbers by being round-headed, but on the whole we can assume that the Turkish rule has not greatly influenced the ethnic composition of the population of the Jebel Garian.

When the Italians came to Libya, their influences were virtually restricted to the establishment of demographic settlements, depending on agricultural production. Therefore, the Italians raised the number of the population in the Jebel without having any intermixture. Hence, the local people retained their racial characteristics.

#### RACIAL GROUPS (See Fig. 25).

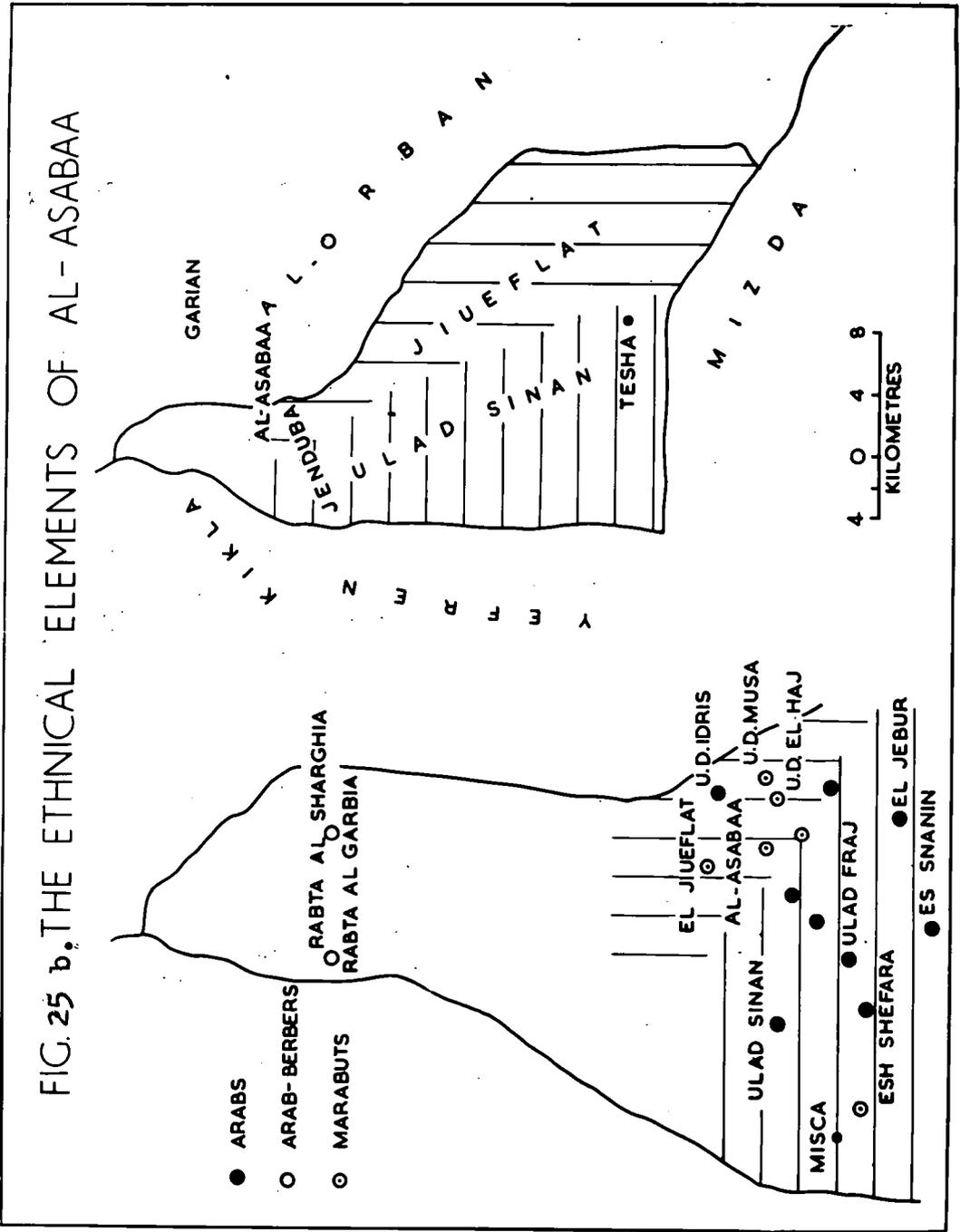
The main racial groups of Garian are therefore Berbers, Arabs, Arabised Berbers and Italians.

##### (a) Berbers:

The Berbers are regarded as the original inhabitants of the Jebel. There are two main confederations of Berbers, the Branes and the Magadis.<sup>(4)</sup> They had come from two localities, north and south of the Auras mountains in Algeria. Later, they spread over the whole coastal zone of Libya, but the majority of them were concentrated in Tripolitania near the coast. They were nomads, wandering with their flocks and herds over the whole Jefara, and used to come up to the mountainous areas only for hunting animals in the forests which existed over the whole of the Jebel Garian and the Jebel Nefusa.



FIG. 25 b. THE ETHNICAL ELEMENTS OF AL-ASABAA



At the beginning of the Arab conquest, they withdrew from the coastal and Jefara plains to the mountainous areas. They were, however, converted to Islam, but the Nalut-Yefren tribes adopted the Kharejite heresy whilst the Garian Berbers favoured the orthodox Sunni doctrines.

The Branes are composed of ten tribal groups which are: Azdagia, Masmuda, Auriba, Agisa, Cutma, Sanhagia, Auriga (Hawara), Lemta, Hascura and Gula.

The Madghis, on the other hand, include only four tribes: Addasa, Nefusa, Darisa and Beni Lewata.

De Agostini<sup>(5)</sup> considered that the Jebel Garian Berbers belong to the Auriga or Hawara which is the main branch of the Branes.

Most of the people in the Mudiriyat Beni Dand, Beni Nser, Beni Khalifa and Al Guasem belong to the Hawara group. The Zenata (which is regarded as the largest group of the Darisa) and the Sanhagia have played prominent roles in the long struggle against the Arabs. There are some elements belonging to the Zenatia still to be found in the Ain Tobi area, where a great battle was fought to the advantage of the invaders who annexed the south eastern section of the Mudiriyat Al Guasem. The Sanhagia, who are noted for the part they played in the wars in Spain between the Almohadi and Almeravdi, in Egypt in the conquest of the Fatimites, and Tunis in the Zenata rebellion (933-947).

#### Distribution.

Of the 15 tribes found in the Mudiriyat Al Guasem, 14 are

Berbers. All the tribes of the Mudiriyat Beni Dand are Berber with the exception of the Kradna, which is considered to be Kologlis. The Beni Nser is also composed entirely of Berber people who have settled either in the larger Wadis (Dannun, Bu Ayyad, Al Yaagib) or over the rocky hill zone such as the Kaam. To 11 tribes in the Mudiriyat Beni Khalifa, there is only one Arab tribe. The Berbers are concentrated along the fertile wadi areas such as Wadi Al Taffah.

(b) Arabs:

The Arabs are made up from two basic branches in Tripolitania, the Beni Hilal and the Beni Suleim.<sup>(6)</sup> The former comprises the Al Atbeg, Beni Riaah and Beni Zogla, with two other groups of mixed descent, the Al Maakil and the Beni Gushem. The Al Maakil is found in the Jaafra tribe of Al Orban Mudiriyat and is the only Beni Hilal group represented in Garian.

There are five main branches of the Beni Suleim; Beni Auf, Beni Debbab, Beni Yebid, Beni Zegb and Beni Heib. The elements of the Beni Auf are found in the Ulad Breck, who occupy the eastern section of the Mudiriyat Al Orban. The Debbab Beni Jaber are found only in the southern parts of the Jebel among the Ulad Sinan and the Al Jiweiflat of Al Assabaa. Most of Asabaa's tribes belong to this branch of Beni Suleim. The descendents of the Beni Zegb are found in the Salahat and Miamin in the southern part of the Mudiriyat Al Guasem.

Distribution. The Arabs are for the most part semi-nomadic being

concentrated on the south and eastern sections of the Jebel Garian, occupying the whole of Al Asabaa and Al Orban with limited concentrations in the four Berber Mudiriyats. In Al Asabaa, there are 18 Arab tribes with a total population of over 6,600 whilst in Al Orban there are 5,000 pure Arabs. Elsewhere Arab settlement seems to have been controlled by the existence of wells and springs and good winter pasture. In some areas, they cultivate cereals and tree crops. (e.g. Wadi Nakhle), whilst elsewhere they have not changed their traditional customs of practising pastoralism east of the Wadi Gan and collecting esparto like the Sadrures, Ben Yarbua, Baderten and Marwan (four Arab groups, of the Zebban tribe)

In Beni Dand, the Arabs lie in the north-western section of the Mudiriyat at the foot of the Jebel scarp, whilst the semi-nomadic Slalma are found along the eastern borders of the Beni Nser and Beni Khalifa.

(c) Arabised Berbers:

These people have originated from intermarriage between the Arabs and Berbers, and bear the racial characteristics of both. (7) They are restricted to the Rabta al Garbia and the Rabta al Shargia who occupy the oasis in the northern section of Asabaa below the Jebel. Their restriction to this area is probably the result of the attraction of both Arabs and Berbers to the water supplies in this essentially transitional zone.

Sherif tribes claim direct descent from the prophet Mohammed. They produce genealogical tables, mostly apocryphal, to prove

their descent. Their title in Garian does not prove that they are really of pure Arab descent. However, they are found in Garian only in the Gmata tribe of Al Orban Mudiriyat.

Marabout tribes claim descent from saints usually buried in the cabila land. They are important groups, originated from Sagia Al Hamra in Southern Morocco, where from the end of the fourteenth century, the holiest pilgrims seem to have been born. They had played an important role during the Middle Ages, as they established a new regime in North Africa. The ancestors of the Marabouts came to Libya from the end of the fourteenth century onwards and spread over the whole of Tripolitania. Some of them went to the Jebel Garian and settled permanently. They intermarried with the indigenous people, and used to act as rallying points and mediators among the hostile tribes. As a consequence, they became very popular and respected people in the Jebel. Moreover, they used to teach children the Koran, and to lecture in Islamic religion for the young people. Later, they established many religious centres such as Jamaa Al Tuahria in Bu Zeyyan village and another one in Kmashat (Al Guasen Mudiriyat). Thus the Marabouts have played a prominent part in the spiritual and cultural life of the Garian Berbers. At present, their influence is weak largely as a result of the spread of modern education among the tribes. However, they are still respected people and the indigenous inhabitants still believe in their goodness.

Some Marabouts are Berbers and others are Arabs. The former are represented by four tribes, Zaviet Abd Al Mlack, Ulad Ben Naji,

Al Fogha and Al Ntatat in Beni Nser Mudiriyat. In Beni Khalifa Mudiriyat, they are two tribes Al Mgarba and Ghebbaa and a small Lahma in Bu Zeyyan, Lahmat Al Tuahria. In Al Guasem Mudiriyat, the Marabout tribes are seven, Kmashat, Al Imamish, Suadia Ulad Bu Jaafer, Shemmas, Ulad Bu Slama and Gararat Al Mrah.

The Arab Marabouts are found in Ulad Ben Yaagub tribe in Beni Dand Mudiriyat and in Ben Jarboa in Al Guasem. In Al Asabaa, the Marabouts form the Bsherat tribe. They are represented by Jaafrah tribe in the Mudiriyat Al Orban.

(d) Kologlis The Kologlis are the descendants of Janissaries from different provinces of the Ottoman Empire and native Arab or Berber women or even Christian women captured by the Barbary pirates. They invaded Libya during the seventeenth century and maintained their rule until the early part of the present century. They are formed in Garian by marriage of some Turkish Janissaries with Berber women. The Kologlis are found in the Jebel in two tribes, Ulad Murad in the Mudiriyat Al Guasem and Al Cradna in the Mudiriyat Beni Dand.

(e) Italians Although the Italians first settled in the Jebel in 1922, it was not until 1933 that they came in large numbers. Apart from the garrison and the administrative officers, the Italians were concentrated on the A.T.I. (Azienda Tobacchi Italiani) settlement at Tigrinna. There was no intermixture of the races because of the great political, social and religious differences. The Italians now number 710, and are found only on the Tigrinna estate in the Mudiriyats Beni Dand and Beni Nser.

(f) Jews Jews were in Garian before the first Arab conquest of Libya in the 7th century. They were regarded as indigenous people in the Jebel, because they had settled in Garian since the days of the Emperor Vespasian. As a consequence of the Arab invasion, their number declined and later increased again in 1391, when Jewish immigrants came from Spain. Racially, some of the Garian Jews are Berbers who have adopted the Jewish faith and thus it was very difficult to distinguish between them and Berbers. However, the Jews of Garian avoided intermarriage with the Berber Moslems, and so they retained their own customs and traditions. They used to live in Tigrinna and their occupation was making instruments, tools, and jewellery in workshops found in some of the troglodyte dwellings. They had a very remarkable name for this sort of thing not only in Garian but also in the whole of Tripolitania. Their total numbers in 1949 were 1,000 people. After the Palestine crisis, they left Garian for Israel.

#### POPULATION GROWTH

Four censuses have been conducted in Garian within recent times. The first was carried out by De Agostini in 1917, two were made by the Italian Government in 1931 and 1934, and the most recent was made by the United Nations in 1954. The two Italian censuses were made on the bases of the administrative divisions during the Italian rule of Libya. Garian, for instance, was including administratively both Kikla and Yefren. Therefore, the figures of 1931 and 1934 gave Garian approximately 73,000 people. This number in fact is regarded as inaccurate. Thus

these figures may be rejected as having little validity to this study.

De Agostini found that the total population in Garian in 1917 was 36,600, the distribution between the six Mudiriyats being as follows:-

<u>Mudiriyat</u>	<u>Population</u>
Beni Dand	7,200
Beni Nser	4,950
Beni Khalifa	5,250
Al Guasem	7,600
Al Asabaa	7,150
Al Orban	4,150
Jews	<u>300</u>
<u>Total</u>	<u>36,600</u>

However, the accuracy of this census is dubious. The count was made between 1914 and 1917 by administrative officers, that is during the war and in a period of general unrest in Tripolitania. Secondly, the indigenous population were suspicious of the census, recalling that Turkish counts in Tripolitania usually preceded taxation or conscription. Moreover, De Agostini seems to have had a propensity for round figures indicating rough estimates. Nevertheless, it is a useful means of comparing the population at the beginning of the Italian period with that of the present day.

The 1954 census gives the following figures:- (9)

<u>Mudiriyyat</u>	<u>Population</u>		<u>Increase or Decrease 1917-1954</u>	<u>Percentage Increase or Decrease.</u>
	<u>1917</u>	<u>1954</u>		
Beni Dand	7,200	7,685	+ 485	+ 6.3%
Beni Nser	4,950	3,865	- 1,085	- 26.5%
Beni Khalifa	5,250	3,734	- 1,516	- 30.1%
Al Guasem	7,600	6,708	- 892	- 13.4%
Al Asabaa	7,150	6,912	- 238	- 3.5%
Al Orbah	4,150	5,232	+ 1,082	+ 20.2%
Jews	<u>300</u>	<u>          </u>	<u>          </u>	<u>          </u>
<u>Totals</u>	<u>36,600</u>	<u>34,136</u>	<u>- 2,464</u>	<u>- 100.0%</u>

A comparison between the figures shows a general decline in number of 2,464. This decline may be attributed to three main causes, first of which were the wars of conquest and rebellion that lasted between 1911 and 1923 in Tripolitania. The rebellion in particular was suppressed with great severity. Secondly, migration was considerable particularly during the early Italian period and during the drought years. Moreover, Italians expropriated the indigenous population of much of their sowing and pasture zones.

### Age Structure

Age structure is particularly important since it shows the effects of population movement over a number of years as well as providing an indication of future population movement. It is particularly important in Tripolitania, where there are no accurate birth or death rate statistics.

Most under-developed countries are at the primitive stage in

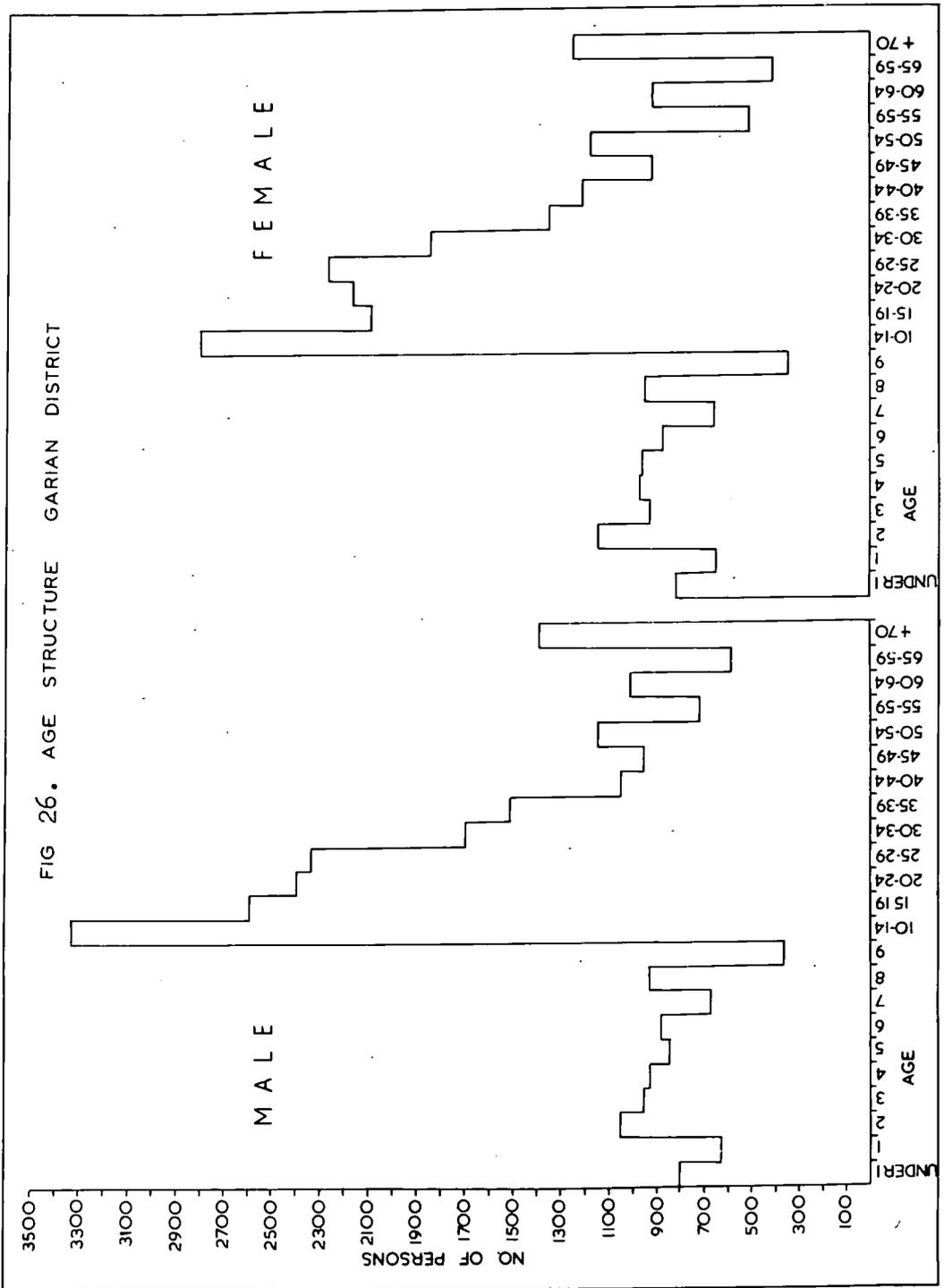
population cycle that is that age structure is determined by high birth and death rates. Most Middle Eastern countries are emerging into the second or "early expansion" stage with declining death rates and high birth rates.<sup>(10)</sup> In such populations, it is normal to find at least 40% of the population under the age of 15 with a very low percentage over 60 years old. The older age groups often reflect the disorders which have been characteristic of these countries over the past 50 years. Another important feature in Mediterranean states is the difference between the age structure of rural and urban areas on account of migration.

To this pattern, Libya is no exception. Tripolitania is reaching what Rostow termed the "take-off" stage so that the first effects of falling mortality are being felt in the urban areas. 30% of Tripolitania's population is under 15 years of age. The proportion rising to 40% in the rural areas but falling to 33% in Tripoli. In Tripoli, however, 21% of the total population and 22% of the male population is aged between 20 and 30 years compared with 12-15 in the Jebel.

Age Structure in Garian (Fig. 26 shows the population of the Jebel Garian. 30% of the population is under 15 years of age. There are significant indentations in the figure in the age 20-25, 30-34, 45-49, and 55-59. These indentations are typical in Tripolitania except that Tripoli shows in the 20-30 age group. These indentations may be related to the recent history of Tripolitania which is summarised below.<sup>(11)</sup>

1900-1910. Tripolitania was a backward province of the Ottoman

FIG 26. AGE STRUCTURE GARIAN DISTRICT



empire during this time. The Port was struggling with internal dissensions in the Balkans and with the time of the "young Turks" movement. Unrest was produced in Tripolitania by, on one hand, the growing weakness of Turks and on the other by the Government's attempts to impose increased taxation and conscription. As a result, emigration to Tunisia developed.

1910-1917 The Italians invaded Tripolitania in 1911 and the Jebel had been conquered a year later. After 1914, the tribesmen revolted and drove the Italian to the coast. Anarchy prevailed in the Jebel.

1920-1925 During this period, the Italians re-conquered Tripolitania. The tribesmen were classed as "rebels" so that the Fascist government and Ascari troops showed no mercy. At least 5,000 people from the Jebel died as a result.

1925-1935. In this period, land was confiscated for Italian colonisation. The resultant disruption of the local economy meant that emigration grew rapidly.

The age groups 45-49 and 55-59 were particularly involved in the early fighting whilst the age group 30-34 was born during the re-conquest. The indentation in the 20-25 age groups is a reflection of the extensive nature of emigration from the Jebel which appears to be of a temporary nature since a more normal balance is found in the 25-30 age group.

#### Sex Structure

The ratio of males to females shows adverse balance. The sex ratio of the Jebel Garian shows an excess of males over females as follows:-

POPULATION OF GARIAN, 1954

<u>Mudiriyat</u>	<u>Both Sexes</u>	<u>Males</u>	<u>Females</u>
Beni Daud	7,685	4,078	3,607
Beni Nser	3,865	2,003	1,862
Beni Khalifa	3,734	1,876	1,858
Al Guasem	6,708	3,382	3,326
Al Asabaa	6,912	3,626	3,286
Al Orban	5,232	2,696	2,536
Totals	<u>34,136</u>	<u>17,661</u>	<u>16,475</u>

However, the accuracy of these figures may be called to question. In a primitive and Islamic society, discussion of the number of wives or daughters, which a man may have is considered impolite and thus the actual number revealed to a census counter is unlikely to be true. It is probable that the number of females is greater than would appear in the census and that the sex ratio is less adverse towards the females than at first sight.

Thus the average position is something less than 1009 males per thousand females. This figure is greater amongst the Berber settled peoples than the semi-nomadic groups.

Level of fertility.

A rough measure of the fertility of the Libyan woman is furnished by the ratio of children under five years of age to women between 15-19 years old as enumerated in both 1936 and 1954 Censuses. This ratio is calculated at 683 children to 1,000 women in 1936 and 672 children to 1,000 women in 1954,

while the ratio for Tripolitania in 1954 is only 666 children to every 1,000 women. These figures suggest that Libyan women are relatively fertile and consequently they imply a very high birth rate of about 35-40 per thousand population in 1936. The crude birth rate in 1954 for Tripolitania is about 39 per thousand of population, although less than the rate of 41% for the whole of Libya. (12)

This fact is associated with the high marriage in Libya as a whole, because under Islamic law, it is possible for men to marry up to four wives and divorce may be simply obtained. The divorce rate is high and probably has a great effect on the level of fertility. Divorce is in fact the consequence of infertility, age and the unfortunate practice of bridegroom and bride meeting for the first time on the wedding day without any previous friendship between them. Polygamy is not widely practised today, being restricted to the older age groups and only among the wealthy people in the Jebel. Its percentage does not exceed 4.5%, whilst the percentage of males who are married to one wife is about 95%. In general polygamy is going to disappear particularly among the educated people.

In the Jebel Garian marriage costs are very low, especially among the semi-nomadic people of both Al Asabaa and Al Orban, but the costs are slightly higher among the settled people of Beni Daud, Beni Nser, Beni Khalifa and Al Guasem. Only about 4% of the males and 2% of the females are single after the age of forty. The average age of marriage in Garikan would appear to be 25-30 for males and about 20 for females.

The season for marriage is during the summer and autumn, when the people finish harvesting. Families tend to be large, when not too reduced by mortality, and include in Garian about four children on the average.

Level of mortality.

There are no statistics in Libya on the number of births, deaths and migration. It is only possible to indicate the position of Tripolitania and the Jebel Garian with reference to conditions elsewhere in Tunisia, Algeria, Morocco and the Middle East. It is estimated that the death rate in Libya as a whole is 35 per thousand.<sup>(13)</sup> It must be noted that in a primitive economy, the death rate is always high, because knowledge of modern hygienic methods is almost entirely absent. Moreover, the water conditions which comes mainly from the primitive cisterns are thus not very good and clean as in Tripoli or Garian town. This phenomenon is found in Beni Daud, Beni Nser, Beni Khalifa, Al Guasem and Al Asabaa where the fresh water is limited and does not suffice the requirements of the native population. In addition, the poor food which does not contain either rich protein or fresh vegetables has greatly influenced the health conditions of the people. Moreover, infant mortality is also high due to lack of milk and adequate infant food. Diseases such as Pulmonary Tuberculosis cause high death rates in the region which mainly resulted from poor food and the type of settlement (mainly troglodyte dwellings) which have no facilities as for instance, windows, bathrooms and

modern kitchens.

D. DISTRIBUTION AND DENSITY (See Fig. 27 ).

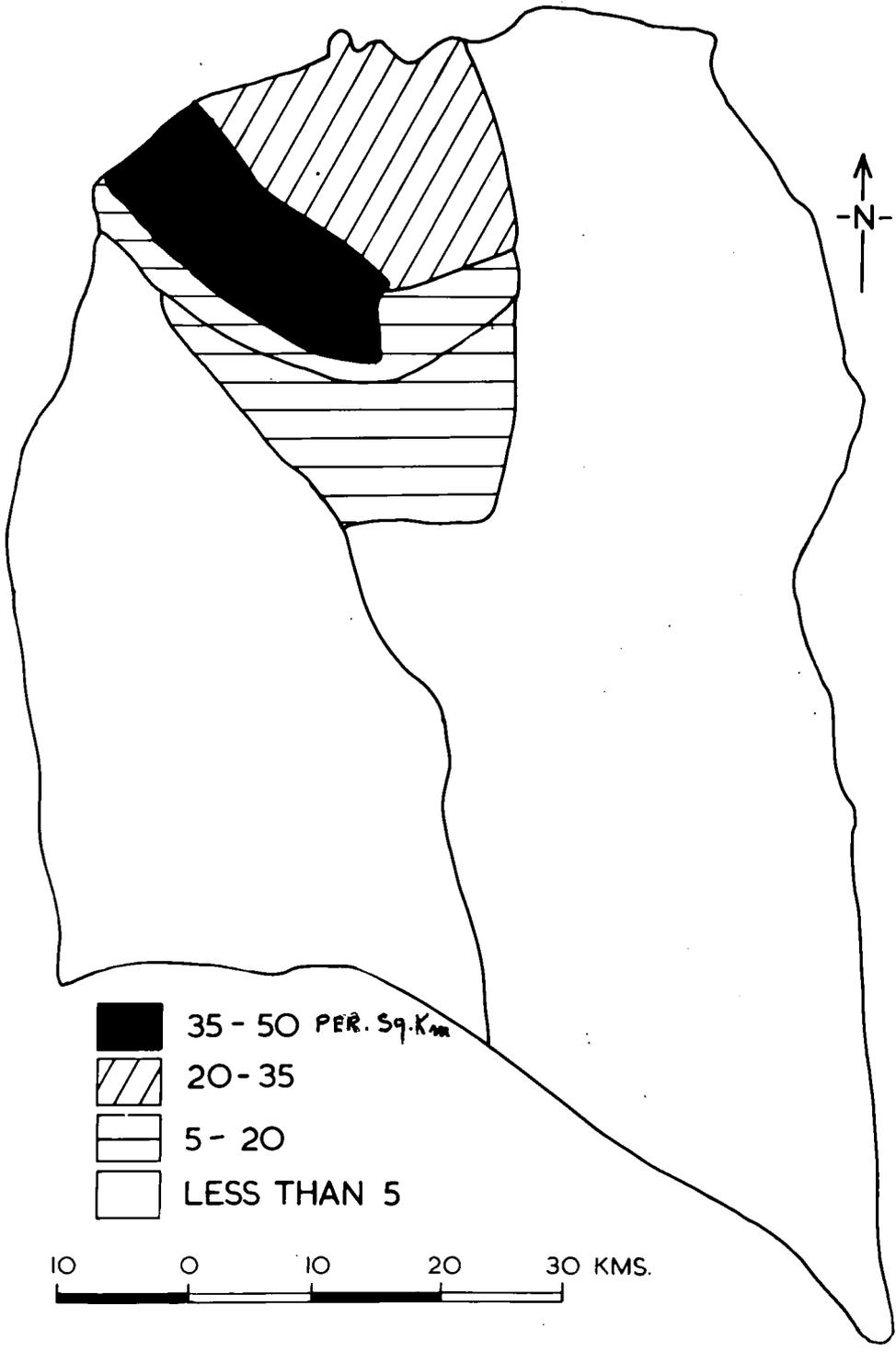
Beni Daud is the largest and most populous area in Garian. It has a population of 7,685, and the population density of the Mudiriyat is 50 persons per sq. kilometre. The reason for this high density is not only that it is the most fertile area in the Jebel but it also contains Garian town, the chief marketing and route centre of the Jebel. However, the bulk of the population is concentrated in the eastern zones as the west with its rugged and denuded hills is unfavourable for extensive cultivation. The Jefaran zone of this Mudiriyat, Gattis, is settled by semi-nomadic Arab tribes.

Al Asabaa with a population of 6,912 in 1954 is the Mudiriyat with the second largest population. The population is totally composed of wandering pastoralists, who show a decline in number of about 250 since 1917 for the reasons outlined above. The population density of Al Asabaa is two persons per sq. km. This density in fact is very low compared with the other Mudiriyats. Most of the peoples are concentrated in a small section in the north of it. In addition, there are two Arabised Berber groups who are solely restricted to the oases of Rabta al Garbia and Rabta al Shargia.

Al Guasem has suffered a decline in population of nearly 900 people since 1917 to the present level of 6,708. Within the Mudiriyat, the actual distribution is depending on morphology in relation to soils and water supply. Thus, in the southern

FIG. 27.

POPULATION DENSITY



part, there are seven tribes. Here, a number of large wadi depressions facilitate cereal, vegetables and tree cultivation whilst in the western parts the arid rocky hills limit fertility. Thus high population densities (30 persons for each sq. km.) are found in the flat zones, whilst in the accidented areas, density is very low.

The population of Al Orban is about 5,340 showing an increase of 840 people since 1917. Therefore, the Mudiriyat Al Orban is considered the second one whose population increased. This may be assigned to the remoteness of this zone from the main area of Italian activity, a factor which may have encouraged immigration during the Italian period.

The decline in the population of Beni Nser to the present figure of 3,865 is about 1,085 since 1917. This is due to the normal migration factors of the Jebel supplemented by the greater aridity of this area. Also, the Italians confiscated land in this zone, thus robbing the indigenōus peoples of their means of livelihood. Population is concentrated in the eastern part of the Mudiriyat, whilst the western zone with ragged bare hills, dry wadis and only limited areas of agriculture is sparsely populated, about 18 persons per sq. km.

This western zone is the homeland of four tribes, the Bu Ayyad, the Al Yaaghrib, the Zaviet Abd Al Mlack and the Dannun, who cultivate on the minor terraces in the larger wadis. Decline in number has not been great among this group, due probably to the fact that Italians found the land unfavourable for

colonisation. However, there has been no increase in population as in Beni Nser, because of the low volume of water issuing from the springs, and the irrigation methods employed which do not favour extension of the cultivated area.

The population of the Mudiriyat Beni Khalifa in 1954 was 3,734 showing a total decline since 1917 of 1,516, due to the reasons already outlined. The most fertile areas such as the Wadi al Taffah and the Wadi al Njusat are the most densely populated. The western zone of the area is sparsely populated due to the existence of bare hills and dry wadis. However, the whole population of the Mudiriyat is concentrated in a small section of the area, whilst the rest is largely deserted. The population density of the Beni Khalifa is 16 persons per sq. km.

#### E. MIGRATION

Initially, a differentiation between the pastoral migrations of semi-nomads and emigration from the Jebel Garian must be made. Here, the concern is with the latter though in fact it is much influenced by the former. Four periods of migration from the Jebel may be recognised.

1. 1900-1914. Considerable migration from the Jebel occurred in this period as the result of Turkish demands for troops. It was mainly directed towards Yunisia but no statistics are available to enable one to determine volume.
2. 1914-1923. The Italian conquest resulted not only in great loss of life among the indigenous population but also in

punishment involving loss of land and water rights. Further resistance to the Italians was maintained from bases first in the Ghibla then Cyrenaica with eventual withdrawal to Egypt and Tunisia. Of these, many settled permanently in Tunisia particularly some groups from the Mudiriyats Beni Daud, Beni Nser, who lost their lands, but some groups of the Mudiriyat al Guasem, especially from Egypt, returned after the war. In addition, some tribes from both Mudiriyats al Orban and Al Asabaa migrated to the deep Ghibla.

3. 1923 - Present day. There has been considerable migration to Tripoli in search of work during these years. Some of this migration has been permanent but it has been mainly of a temporary nature. There are still a large number of people leaving the Jebel temporarily either for the autumn harvest in the coastal plantations or in search of work in Tripoli during the summer months. This migration occurs on a large scale from the settled and semi-nomadic peoples of the Jebel.

4. Drought years. There were several droughts in the years 1927, 1935, 1940 and 1947. This resulted in large numbers leaving Garian temporarily and seeking work either in Tripoli, Benghazi or in Tunisia.

A considerable bulk of this emigration has been of a permanent nature and thus has adversely affected the natural increase. Temporary migration is, however, of greater importance numerically and most families seem to have at least two members working in the coastal towns.

Moreover, of the Italian settlers who came to the Jebel Garian in 1933 in order to colonise the lands over the mountain, only 10% now remain, the rest having either returned to Italy or migrated to the coast.

#### FUTURE POPULATION.

It is difficult to prognosticate on the future of the Garian population. Increasing knowledge of basic hygiene, greater medical facilities and child-care may be expected within the next few years. This may well lead to a fall in death rates and possibly to greater migration. At the moment, it may be said that marriage rates rise and fall according to rainfall. Rainfall determines the success of crops; in good years the marriage rate is high, and the reverse in drought years.

The situation may be altered by increasing the area under agricultural production and by adopting the techniques so successfully employed by the Italians at Tigrinna. This would mean greater sedentarisation of the population with a trend away from pastoralism. This is the only solution for the Jebel Garian and will not only help to raise population numbers but also provide them with a livelihood.

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## CHAPTER XIII

### SETTLEMENT

#### EVOLUTION OF THE SETTLEMENT

The pattern of settlement in the Jebel Garian is unique as far as the rest of the escarpment is concerned. The inhabitants of Garian have special racial and cultural features that distinguish them from the inhabitants of the Jebel Nefusa and the Jebel Tarhuna. These differences are reflected in the settlement pattern.

The ancient pattern of settlement differed from that of the present day. The ancient villages are found in the southern parts of the Mudiriyat Al Guasem and in the Mudiriyats Beni Nser and Beni Khalifa. In these areas, the villages are sited either on hill tops or on the upper slopes of the wadis. Msufin, Usaden, Cleba, Slahat and Sadrura are examples of the first type whilst examples of the latter include Bu Ayyad, Dannum and Yaaghib. Today, many of the villages are uninhabited but people still live in a few of the villages, notably Slahat, Msufin, Usaden, Ghebaa and Cleba.

These villages were obviously sited in relation to defence. Despite the fact that stone built houses were expensive to construct, the population selected these sites in remote areas to avert the attention of marauding nomads. The Berbers are also proud of their own special language and traditions and thus wished to live in isolation.

A second type of settlement with ancient origins is found in the Wadis el Arbaa and Gan. Defence against ferial and human marauders is again important in their location whilst good agricultural land was available in the wadi beds.

Other ancient villages are related to the Roman and later Romano-Berber settlement. The only significant Roman settlements were found in both Msufin and Al Asabaa. Goodchild<sup>(1)</sup> has found in this ancient village numerous fragments of Christian inscriptions of the fourth century A.D., in which the "opulence", "abundance" and prosperity of God were praised. He also discovered in Msufin numerous Roman olive presses. In Al Asabaa, Haynes<sup>(2)</sup> stated that the Romans had built a church in 211-217 A.D. which is situated now about three kilometres north-west of the Mudiriyat of Al Asabaa and one kilometre south of Ras el Wadi. The site is on high ground overlooking the Jebel escarpment and there is also a fortified farm less than a kilometre away to the east. In addition, there are many Roman remains found in Wadi Crema and Bir Cur in Al Orban and Slahat.<sup>(3)</sup>

However, each ancient Jebel village surrounds a central Gasr or fort which has been very important for defence of the inhabitants of the village. Most of these forts have so far been significant for the Jebel Berber, and Slahat is the only exception which lost its validity since the Arab tribes occupied it and abandoned the function of the Gasr. They were attracted by the existence of a good water supply near the surface and a generous

number of date palms in the vicinity. Though the Arab tribes do not generally tend to settle in one place permanently, they found themselves obliged to settle near the oases in order to cultivate the suitable lands for agriculture and obtain their requirements of water for home consumption. Thus Slahat was the only Berber village which has been conquered by the Arabs in Al Guasem and represents a good example of the influence of the foreign invasion in the Jebel, and their attempts to mix with the Berber tribes. There were many geographical factors which encouraged the advance of the Arab elements towards the Jebel. The most important one is the Wadi Gan. By this wadi, the Arabs entered Garian and occupied Slahat. Some other Arab elements came from Bu Gheilan and spread over the whole of Al Guasem, though they tended to settle permanently in Kmashat and Wadi Nakhle, where water supply exists near the surface.

The rest of the ancient villages of the Jebel Garian remained away from the influence of the Arab invasion. So, the inhabitants retained their own traditions and type of settlement, because the function of Arab rule was administrative more than cultural, and intermarriage was not general. This case in fact was dominant in the whole of the Tripolitanian escarpment, but changed later during the Fatimate rule of Libya. Under their regime, many Arab tribes came to Libya in the 11th century A.D. and spread through it. (4) Among them were the Beni Hilal and Beni Suleim who came up over the escarpment and occupied some parts of the Jebel Garian. Some

of them settled permanently and engaged in the cultivation of cereals and arboriculture in Wadi Nakhle where the underground water resources are available, but the majority of the Arab elements maintained their own old traditions. They favoured their own former life, namely, practising shifting cultivation and pastoral activity. Those tribes spread into the whole eastern and western parts of the Jebel. The Beni Hilal settled in Al Orban and the Beni Suleim occupied the plateau of Al Asabaa. These tribal areas were favourable zones to the Arabs since the surfaces of land and the climatic conditions are to some extent similar to their original home in the Arabian Peninsula. Thus the incoming elements have not affected the settlement pattern prevalent in the Jebel. On the contrary, the Berbers were very suspicious of the Arabs and always avoided intermarriage with them, and kept away in their isolation.

During the Turkish rule of Libya, no development took place in the settlement of the region. Disturbances and anarchy increased and many clashes occurred between the sedentary Berbers and the Arab nomads especially during the years of drought when there was lack of food supplies. At the end of the Turkish rule, security was found to some extent and as a result of this, some Berbers families left the main villages to settle near their own cultivated land in troglodyte dwellings. This movement increased in scale during the Italian occupation which encouraged the people to settle outside the ancient villages without feeling any

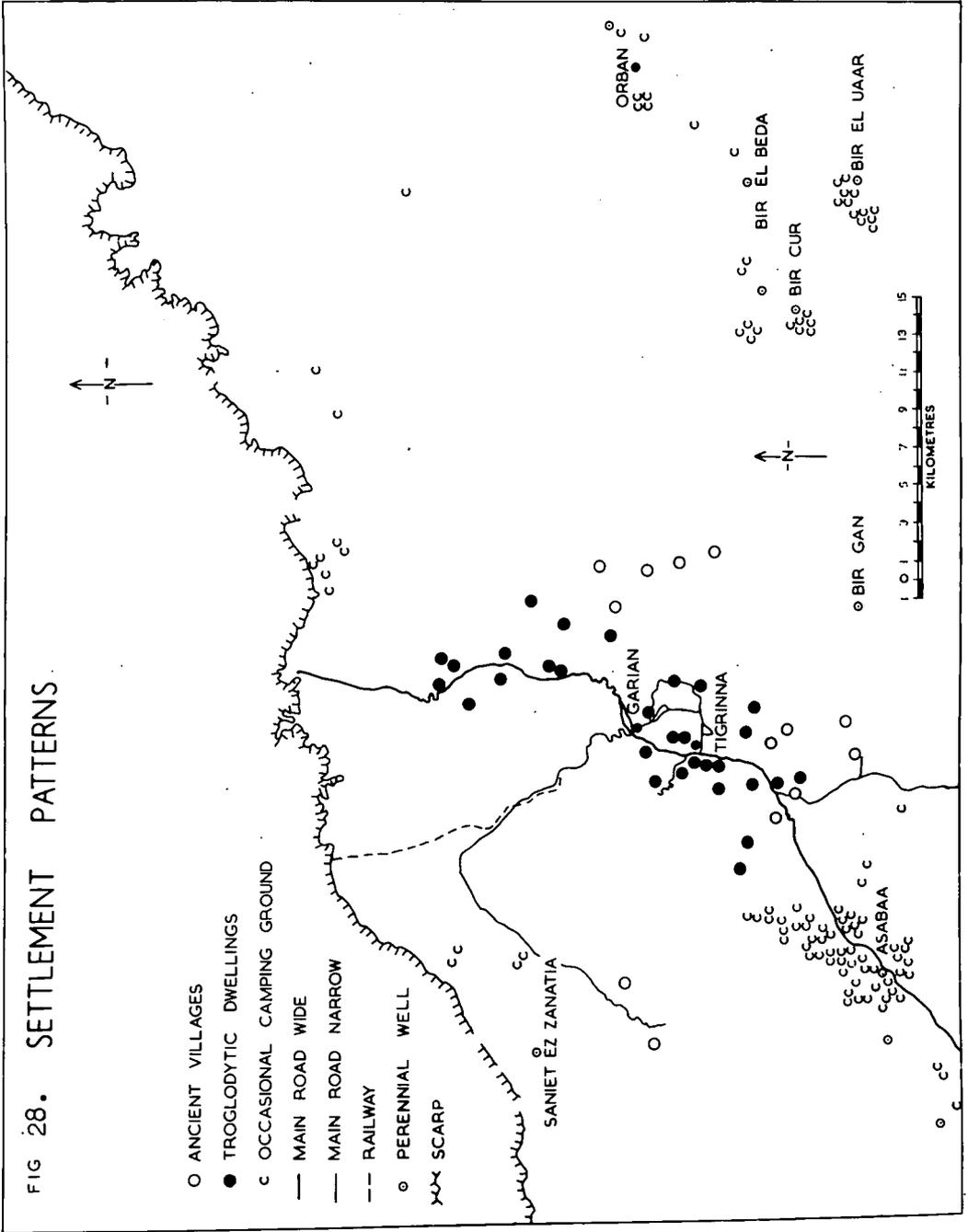
insecurity. Hence, the Italian administration has affected considerably the migration of the villagers away from their ancient homes to the troglodyte centres and the migration increased so rapidly that some villages were completely vacated by their inhabitants, as for instance, Tbadut, Magarba, etc. Even the smaller indigenous groups who were accustomed to live on the slopes of the wadis, migrated to settle in dispersed troglodyte villages, i.e. Dannum and Yaaghib. Generally speaking, this movement of the villagers from the summits of the hills to plains represents a very significant break with tradition. In spite of that, the tribal system remained the same. However, shifting to this sort of dwelling is not progress but rather regression since the ancient houses were more civilized.

#### SETTLEMENT MORPHOLOGY

The settlement morphology in the Jebel Garian is of basic interest to the geographer, and may be classified into three types: ancient villages, troglodyte dwellings and modern Italian settlements. (Fig. 28).

Ancient villages vary from small to large units, according to the geographical position and the origin of the inhabitants. Both the villages which are situated on rocky summits of limestone hills and those found on the slopes of wadis consist of groups of houses. Most of these summit villages have a well developed morphology aligned along the main through road, whilst others on the wadi slopes contain only a few haphazardly sited houses. The hill-top villages as a whole tend to be sited overlooking a

FIG 28. SETTLEMENT PATTERNS



small tributary of a main wadi, as for instance at Cleba, Msufin, Ghebbaa and Slahat. The secondary village type is exemplified in the settlements at Bu Ayyad, Dannum and Yaaghib, where the only common denominator is the amorphous and immature morphology.

(a) The big ancient villages include Ghebbaa, Usaden, Cleba and Slahat (Plate 12). The settlement morphology of those villages is almost identical, with the village centre situated on the top of a rocky hill and with the houses spreading down the hill sides. The houses are built close together, but there are many small alleys penetrating the village from the main through road which generally traverses the village parallel to the tributary of the wadi. Every house contains four rooms, one kitchen and a court-yard. The area of each room is very small. One family in many cases settles in one room, and thus as many as four families share one house only. No sanitary facilities are available. There are many shops which usually lie adjoining the main road, selling food stuffs and acting as cafés. The market is situated away from the built houses. Formerly, each village had a specialized market, but now the official market of all villages exists in the administrative centre of the Mudiriyat, or Garian town. Moreover, each village has a castle (Gasr) which is usually situated on the highest point in the village, and whose function was the defence of the inhabitants of the village in case of danger (Plate 13).

The materials for building consist mainly of limestone, which is available everywhere in the Jebel. Besides limestone, gypsum

is regarded as an essential material of construction, being available in good quantities in Bir el Gnem and Mizda; in other words, it was imported from outside the region. The construction of houses was a difficult task, because of lack of specialised labour. All neighbours must help with construction if anyone wants to build a house for himself. There is no pre-arranged plan for each house. Some courtyards are square whilst others are rectangular, but both are so that the women can move about freely but unobserved. Generally speaking, the characteristics of those ancient villages are typical of the Turkish style of building. Each village has one or two mosques built in the orthodox pattern of Muslim architecture. Finally, the development of the ancient villages has now stopped, due to increasing numbers of people migrating from hill-top to plain. The village almost shows a daily decrease in population, and a lot of houses are falling into ruin. Nevertheless, there remains still, within each village, a nucleus of well preserved dwellings belonging to the established Mudiriyan hierarchy.

(b) The morphology of the small ancient villages is variable. Most of them exist, for example, in Mudiriyat Beni Khalifa, Shamsa, Beni Uzir, Magarba and Tbadut (Plate 14). Those villages are situated on high land, on mainly limestone rocks. Most of the dwellings of those villages are in ruins and their inhabitants have migrated to the plains to settle permanently in troglodytic dwellings. This kind of village has no particular morphological

form and generally they are merely a group of houses situated on any rocky hill. This may indicate that the old Libyan Berbers were settled sparsely in many villages in the area. On the other hand, the villages which exist on the slopes of wadis still retain their old style of building as for instance at Hojra and Bu Ayyad both in Wadi Torshin. The villages as a whole do not bear any definite shape, Hojra consisting of a few houses on a minor terrace of the wadi, and Bu Ayyad comprises several houses scattered sparsely on the slope of the wadi. The number of inhabitants in this wadi is very limited, because the construction of houses is very costly, and transportation of building materials is quite difficult, since the slopes of the Torshin are very steep. There is neither mosque nor school in Hojra and Bu Ayyad (Plate 15).

In addition to the two villages which have been considered, there is another interesting village in Wadi el Arbaa known as Yaaghib. This old village is now also ruined and most of its inhabitants have migrated to settle in troglodytic dwellings.

The second major type of settlement in the Jebel Garian is the troglodytic village. This sort of dwelling is the dominant feature of the present settlement of the Garian area, and is increasing rapidly in importance as the ancient hill-top villages decline. The movement from the hill-top to the plain started at the end of last century and subsequently increased on a large scale during the Italian and British occupations of Libya. This trend reflects many economic and political aspects of the Jebel

Garian. The economic aspect appears in lack of the capital to build and maintain houses which cost a lot of money, and the lack of an organised labour supply. The local people found that digging a troglodytic house was cheaper than building a house above ground. Moreover, the troglodytic houses generally are warm in the winter and cool in the summer.

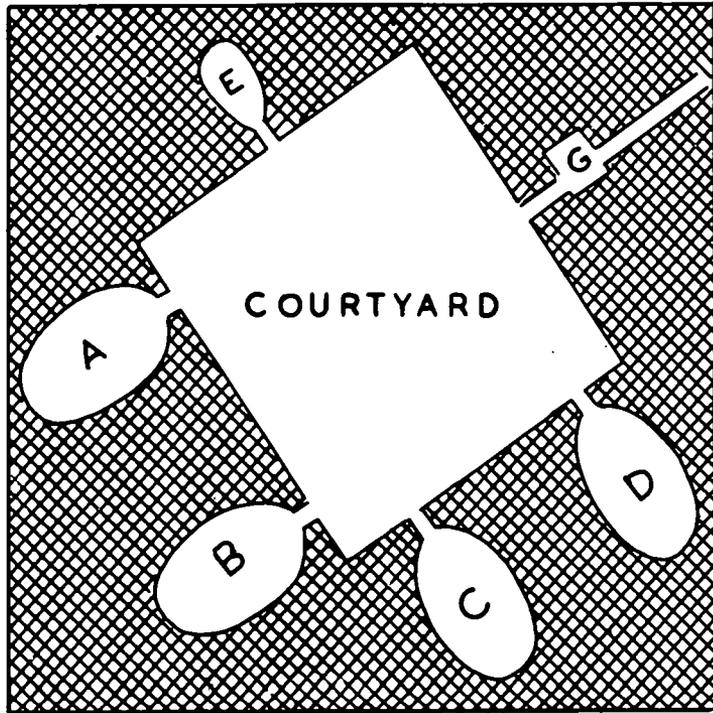
The new Garian troglodytic settlement has no characteristic form above ground. It is possible to divide troglodytic villages into two types: horizontal and vertical. The first one is more primitive, because it is built into the rocky sides of cliffs. (Plate 16). It consists usually of one or two rooms and a very small kitchen. In front of the rooms, there is a courtyard open to the sky. This sort of cave dwelling is common among the poor people, for instance of Slahat, Marwan, Yaaghib and in Mudiriyat Asabaa and their number is 550. The latter are considered as semi-nomads as they do not actually settle permanently in one place. This type exists also in Al Orban.

The second kind of troglodytic settlement is very important, because it is found on a large scale in the whole Jebel Garian. Their total number is 6,242. This style of cave dwelling is identical in all the four Mudiriyats of Guasem, Beni Daud, Beni Nser and Beni Khalifa. <sup>(5,6)</sup> The troglodyte house is generally in the form of a very large excavation in the clay beds, usually 50 feet square, comprising four rooms and a small kitchen (Plate 17). The size of each room differs from one house to another, and takes

Fig. 29.

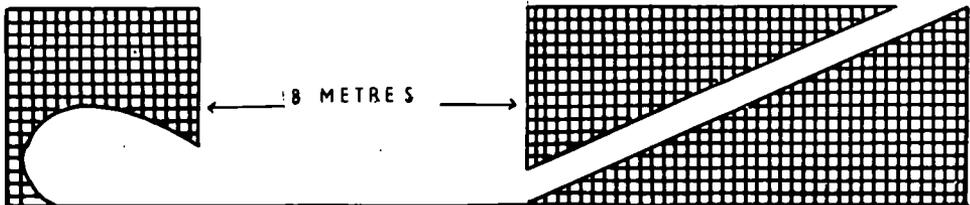
# TROGLODYTE DWELLING

## PLAN



A, B, C, D. : ROOMS : E: KITCHEN : G: STORE

## PROFILE



the form of an excavation in the clay formation. (Fig. 29). There are no windows, but the walls are white-washed. The courtyard frequently measures 36 sq. metres in area, is open to the sky and surrounded by many entrances to the rooms. The actual "front door" of the underground houses is some distance away at the top up a long series of steps. The furnishings consist usually of rugs, carpets and some local plates. Outside of every troglodytic dwelling there is the "Hosh" which is generally a square wall up to two metres high surrounding the entrance of the troglodytic house. In one corner of the "Hosh", there is a room (Marboa) which is a reception place for visitors and guests. Both the "Hosh" and the Marboa are a general feature in troglodytic houses.

Roads and streets in the troglodytic village tend to follow no clear pattern. In other words, there is sometimes a public road, but it ends by disappearing into a maze of small tracks which are the main communication within the village. There are in fact no overall common characteristics to this network of communications. They are usually narrow and a great obstacle to modern means of transportation, except landrovers and other specialised vehicles. Some of them were enlarged by the Italian administration in order to provide access for the Italian farmers to their lands. Those tracks are now secondary roads which lead to the agricultural areas in both Beni Daud and Beni Nser. The tracks which did not interest the Italian settlers were neglected. This type of minor track

exists on a large scale in all the troglodytic areas. Sometimes, quarrels occur about ownership of tracks, since some farmers plough them up for cereal cultivation and impede access. Hence, the tracks change direction every year especially in Al Guasem, Beni Nser and Beni Khalifa.

### THE MODERN ITALIAN SETTLEMENTS

The area of study covered in this survey of the morphology of the Italian settlements includes Tigrinna Village and all farm-houses occupied by Italians in the two Mudiriyats of Beni Dand and Beni Nser.

(a) Tigrinna Village This village can be regarded as a good example of the modern type of Italian settlement (Plate 18). Tigrinna at the present day, still has the essential function of an agricultural centre, even though the Azienda Tobacchi Italiana did not complete the planning of the village due to the beginning of World War II. Tigrinna village is in the centre of an agricultural area, directly south of Garian. The main purpose behind the establishment of this village in 1933 was to answer the needs of the Italian colonist farmers. The village is small and simple, with only one main road (west to east) dividing the village into two parts; the upper half overlooks the northern agricultural area, and the lower half overlooks the southern. Within the village itself are several houses which belong to the Azienda Tobacchi Italiana (Plate 19), a school, a church, a modern olive press and the offices of the Mudiriyat Beni Nser. On the outskirts of the village there are a multitude of privately owned

cafes, and farmhouses.

Planning development by the Italian Agency was terminated by the war, and since that date, no further construction has been carried out.

(b) Farmhouses

The building of farmhouses by the A.T.I. in the Mudiriyats Beni Dand and Beni Nser was started in 1933 and ended in 1939, when 356 farm houses had been completed<sup>(7)</sup> Their distribution is as follows:-

200 farmhouses in Beni Dand

156 farmhouses in Beni Nser

Each of the houses contains three rooms, a kitchen etc., and is situated in a cultivated two or three hectares of land (Plate 20). From the farmers' point of view, the houses are convenient for his needs, for the rooms are large, and water and electricity are available in each house. An annex to the farm building has been constructed at the rear of every farmhouse, which can be used for stalling the animals and storing forage. A.T.I. constructed a cistern of 200 cu. m. capacity for each house, which collects the water which drains from the roof during the infrequent downpours.

Though the farmhouses which the Italian colonists occupied were uniform in every way, they were well adapted to the environment, and were reasonably cheap to build. The geographical distribution of the A.T.I. farmhouses is mainly confined to the eastern part of the Jebel Garian in the Mudiriyats of Beni Dand

and Beni Nser, though most of the settlers' houses are concentrated in the former Mudiriyats, where there are about 356 of them. The layout of the estate does not follow any strict geometrical pattern, and the houses are scattered in pairs across the terrain where they provide the best access to the agricultural area attached to them. Generally, the two houses comprising any pair in this estate are close together, and give living accommodation for two families (See fig. 34)..

The A.T.I. constructed a complete net of roads between Tigrinna village and Garian town, and completed three main roads to link the farmhouses on the estate. The most important road crosses the land of the Tegassat tribe and connects with the main Tigrinna-Garian road, with various extensions to other areas in the Mudiriyats of Beni Dand and Beni Nser. A second important road originates to the west of Tigrinna on the Garian-Yefren road, and comes to an end to the east of the Kammun tribal area. In addition, there is another major road, which connects Tigrinna with the southern Italian settlement in Maad.

Generally speaking, the roads serving the area are good, being well maintained, and make accessible all the agricultural terrain.

#### RURAL SETTLEMENT PATTERN

By far the greater part of the population in the Jebel Garian is rural, hence any survey of the rural settlement of the area must be considered in terms of the Jebel as a whole. It is possible to classify the inhabitants of the rural districts

into two categories; the settled population; the semi-nomads. The first category includes the four Mudiriyats of Beni Daud, Beni Nser, Guasem and Beni Khalifa, whilst the second is made up of the Mudiriyats of Al Asabaa and Al Orban. Of the inhabitants of the Jebel Garian, some 64% are sedentary, with the total population of the four Mudiriyats comprising some 24,689 of the settled tribes of the district. For the purposes of this study, an individual survey of the settled inhabitants of each Mudiriyat will be undertaken, to give a more detailed picture of the geographical background to this aspect of settlement in the Jebel Garian.

(a) SEDENTARY PEOPLES

1. Mudiriyat Al Guasem

Mudiriyat Al Guasem occupies a very interesting area of the Jebel, which is 222 square kilometres extending from Wadi Gan in the east, to Wadi Bu Sheba in the west, from the Jefaran plains in the north to the lands of Beni Nser in the south. The whole of the population of Al Guasem can be regarded as settled, including all 15 tribes which number 7,529 in total. Agriculturally, the people of Al Guasem are dependent upon both arable and stock farming carried on from a fixed dwelling. Though some of the tribes are living in houses, as for instance the Lamamish, Kmashat and Sadrururs, the majority of the tribes are settled in troglodytic villages.

The troglodytic people are dependent upon agricultural pursuits, based mainly on cereals and supplementary crops of

olives, figs, almonds, grapes and vegetables. Where the water table is exceedingly deep, then irrigation is necessary, with vegetables as the main crop, and dates as a supplement. This irrigated area, which includes the lands of Wadi el Nakhle and Kmashat, is a vast depression oasis in the Jebel. The occupants of the oasis are mainly Arab elements who came up to Garian after the 11th century and spread in Mudiriyyat Al Guasem. Some of these peoples live in hill-top villages like Sadrurus, and others are settled in the depression itself, as for instance, the Beni Mahanna and the Kmashat. Originally these tribes were nomads, but have since settled to a sedentary agricultural life.

The bulk of the troglodytes are dependent upon small patches of dry-land agriculture. Some of them in fact utilize terraces on the wadi slopes, for example the Rahba who cultivate the terraces which are found in Wadi Rumman north-west of Al Guasem. Cereals and fruit trees account for most of their production. Agricultural land is, however, insufficient for the needs of the tribes, and there has been an over-spill into the lands of the Gattis plain, which is held in communal ownership, and which is cultivated for cereals by the Jebel dwellers, who move temporarily to the area. This movement depends upon rainfall, but generally it occurs from the beginning of November till the middle of December. The men do not stay away from their permanent dwellings but return to the Jebel immediately the sowing is complete, in order to be back in their lands for the harvesting of the olive

crop. Return to Gattis is merely to harvest the crop and to transport it back to the Jebel, after a break of about a month, usually in mid-May until the end of June.

Pastoralism plays an important part in the lives of the Al Guasem tribes. However, this leaning to pastoralism in no way implies a nomadic or semi-nomadic way of life. The system of flock movement relies on the transfer of flocks to the keeping of professional shepherds resident in the Jefara. The flocks may stay in the hands of the shepherd for a period of a year or more, since there is no opportunity to bring the animals into the Jebel, unless into the Mudiriyats of Al Orban and Al Asabaa. In other Mudiriyats, grazing land is short, and legislation forbids the grazing of herds of goats and sheep.

Rural settlement in Mudiriyat Al Guasem is concentrated in the plain areas of Bu Gheilán and as far as Slahat in the south-east. Wadi Guasem enclaved in the Jebel front, is a highly fertile area, and also supports a dense distribution of population, with correspondingly dense settlement. In the plain areas which adjoin Kaf Tecut and Bu Gannush, settlement tends to be sparsely scattered, with only four tribes settled in the restricted area available for agriculture, to the west of the main road.

## 2. Mudiriyat Beni Daud

Mudiriyat Beni Daud, an area of 153.2 sq. kilometres, lies between the Wadi Bu Sheba to the north-east and the Wadi Arbaa to the north-west. Northwards, Beni Daud extends into the Jefara, whilst to the east, south and west the Mudiriyat Beni Nser

defines the extent of Beni Dand.

Beni Dand embraces twelve tribes with a total population of 7,685. The greater part of the settled population live on the Jebel, almost entirely in troglodyte dwellings. Only the Araifa and Mtanin tribes are semi-nomadic, living in tents, scattered throughout Gattis in the Jefara.

An examination of the distribution of sedentary inhabitants shows that, in fact, they occupy only a small area of the Jebel. The settlements stretch from the south-east of Garian town itself, as far as the southern part of the Menzel el Hag Omran lands. (The distance from Garian to this area is only 5 kilometres). The majority of these settlements lie on the plain that stretches to the east of the main Garian-Jefren road as far as Tigrinna. The more gentle rolling relief, together with the extensive cover of thick Quaternary material, renders this area more suitable for agriculture and hence settlement. To the west of the road erosion is more intense and the land more broken. The area suited for arboriculture and cereals is more restricted than on the east side. Thus seven tribes - Tegassat, Beni Yahia, Ulad Hazam, el Brashish, el Muazin, Menzel Tigrinna, and Menzel el Hag Omran - have settled in the plain area, whilst only six smaller villages are found in the less favoured hill area. The latter include Borg, Ulad Ben Yaagub, Ulad Ali, el Diasir, Cradna and Gasr Tigrinna. Hence, the influence of topography as reflected in slope and soil accumulations influence to a certain extent the distribution of settlement.

The troglodytic settlers are extremely dependent on agriculture. Within the tribal areas, families possess plots of land normally devoted to the cultivation of olives and fruit trees with some vegetables. Some of the inhabitants cultivate small plots and patches of land on the minor terraces of the Wadi Tegasset. Here, dry cultivation prevails. The sowing of cereals in Jebel terrains is practised but it is normally limited to the poor families, who own no land in Gattis. Apart from this exception, the Jebel is almost exclusively devoted to arboriculture and vegetables. Most cultivators possess or have access to land in Gattis, which is devoted to winter barley and wheat. Thus there is some transhumance but this is a restricted form of semi-nomadism and movement is usually of limited extent. It is similar to that of the Guasem tribes.

The Beni Dand tribes send their sheep and goats to Gattis for the winter, where they remain in the hands of Araifa and Mtanin shepherds. Some of the livestock are sent to Al Orban or Al Asabaa.

### 3. Mudiriyat Beni Nser

Mudiriyat Beni Nser is situated to the south of the Beni Dand. It has an area of 197 square kilometres. This area extends from the Wadi Gan in the east to Wadi Usar in the west, being defined to the south by its boundary with Mudiriyat Beni Khalifa. Including the Wadi Arbaa basin and the large plain that lies to the east of Tigrinna village, this is gently undulating with large stretches of flat land covered with a mantle of sandy loams and

sandy clays. Only a few rocky outcrops and the more rugged terrain associated with the wadis el Arbaa, Torshin and Uaur, interfere with the good agricultural potential of this land.

The population of Beni Nser is 3,865. It is composed of twelve tribes. In this zone, settlement is concentrated entirely on the Jebel and only one of the tribes may be described as semi-nomadic. The eleven sedentary tribes dwell either in troglodytic villages or in stone built surface houses. Examples of the former include es-Segaif, el-Fogha, en-Netatat, Kammun, el-Gahasat, ez-Zuia, Dannun and Yaagib, whilst the latter include Bu Ayyad, Salahat, and Zaviet Abd el Mlack. The semi-nomadic Salalmas are tent-dwellers and they are scattered along the whole eastern part of Beni Nser.

Bu Ayyad and Salahat are ancient villages. The former is situated on the slopes of the Wadi Torshin, whilst the latter occupies a hill-top position between the Wadi Gan and its tributary, the Wadi Wazima.

The distribution of settlement indicates again the fundamental influence of topography on human activity. Thus, the west with its greater slopes, deeper wadis and narrower interfluvial surfaces restricts dense settlement so that in this area there are only four of the tribes: Bu Ayyad, al Yaaghib, Dannun and Zaviet Abd el Mlack. The smoother terrains of the east have attracted the greater number of tribes. Settlement sites among the western group of tribes is also partially controlled by the accessibility of water resources. For instance, Bu Ayyad, situated on the

slopes of the Wadi Torshin, has in its vicinity two springs in the wadi bottom. Again, Dannun is sited near a spring in one of the southern tributaries of the Wadi el Arbaa whilst further down this wadi occur two wells utilised by Yaaghib and Zaviet abd al Mlack. It may be said that topography influences greatly the actual site chosen for settlement whilst the general position is related to the occurrence of ground water. In the Wadi el Arbaa basin, there are 1,121 people, whilst in the plain area the figure is nearly 2,500.

Economic activity among the Beni Nser tribes is limited to agriculture and pastoralism. Although the people possess sheep and goats, which are normally retained in Al Asabaa or Gattis, the population may be regarded as sedentary. The majority own small plots of land or orchards. Most of these plots of land are concentrated on the plain area with a few on the minor wadi terraces towards the foot of slopes in, for example, Wadi el Arbaa and Torshin. These are generally devoted to olives, figs, almonds other fruits and various vegetables in dry cultivation. Some, however, are cistern or flood irrigated. Transhumance is practised for winter cereal cultivation. This limited movement is now exclusively directed towards the Jefara, i.e. Gattis. Formerly, there was a similar movement in the Ghibla Wadis but the Government has taken measures to stop this practice.

The movement, necessary to integrate the resources of the environment as they alter in time, is for pastoralism directed either northwards towards the Jefara or south to the Ghibla.

The majority of the tribes in the eastern section of Beni Nser send their flocks to the shepherds of Salalma and Asabaa. These shepherds take the animals down to traditional pastures of the Ghibla, where winter grazing land is good. This movement takes place in late autumn but with the increasing temperatures of spring the shepherds bring these flocks back to the Jebel where the lower temperatures, and better water resources enable the animals to survive the aridity of the summer months. On the other hand, some of the tribes in the Wadi el Arbaa basin send their livestock to Gattis for the winter but again the lack of watering points and good pasture during the summer force the animals to return to the vicinity of the main wells for the summer. This return is necessary despite the fact that considerable damage is done to the soil and vegetation in the wadis as a result of heavy pressure of grazing.

#### 4. Mudiriyat Beni Khalifa

The lands of the Beni Khalifa occupy a large area, estimated by 231 sq. kilometres extending towards the south rather than the east or west. It lies between Beni Nser to the north, Al Orban to the east, Asabaa to the west and southwards it extends to the Garian-Mizda administrative boundary.

There are eleven settled tribes, of which the total population is 3,734. Two types of settlement may be distinguished: the ancient villages and the troglodyte dwellings.

The ancient villages number six in all and lie generally in the eastern section of the Mudiriyat. They include el Jehesha,

Usaden, Gebaa, Shaatan, Msufin, esh Shama and Cleba. Beni Uzir, Magarba, Bu Zeyyan and Tbadut are troglodytic. The semi-nomadic tribe - Salalma - is scattered over the whole of eastern Beni Khalifa.

An examination of the distribution of settlement in Beni Khalifa shows that the bulk of the villages are concentrated in or near the Wadi el Tiffah and its tributary the Wadi Bu Bielo. In other words, the settlement centres are entirely situated in the most fertile zone of this extensive area. The rest, though suitable for agriculture, does not contain any villages. This can be seen in the case of the Janduba lands, lying in the south west of Beni Khalifa. It is possible that inhabitants reserved this area solely for grazing land on account of the limited watering resources. Nevertheless, the concentration of settlement in one small area of Beni Khalifa reflects the influence of environmental conditions in their establishment.

Agriculture in Beni Khalifa is similar to that of the other Mudiriyats discussed above. Again, there is the dependence upon olives, fruits, and vegetables of dry gardens. Such arboriculture is ubiquitous among the sedentary tribes of the area. Cereals are cultivated in the Mudiriyat on lands of defined ownership. However, the principle zone of cereal cultivation is in Gattis where the families own individual plots. Thus, limited transhumance is practised in the same fashion as in the other Mudiriyats.

Pastoralism is fundamentally directed towards the Ghibla and the southern part of the Mudiriyat Asabaa. The majority of the

flock owners turn over their animals to the shepherds of Salalma and Asabaa who seek for their charges the better pasture below springs in the arid wadis. However, a small proportion of tribal members, as for example the Cleba, Msufin, Gebaa and Usaden, graze their livestock in the vicinity of their own lands. This practice is only on a small scale. In this Mudiriyat is found an example of the integration of the Jefara for cereals, the Jebel for arboriculture, and the Ghibla for winter pasture.

(b) SEMI-NOMADS

1. Al Asabaa

The Mudiriyat Al Asabaa is the second largest area in Garian district. It has an area of 3,550 square kilometres. To the east, it is bounded by Beni Dand, Beni Khalifa, and Al Orban. The confine between Asabaa and Kikla follows the Wadi Zaret. Northwards, the Gattis lands occur, whilst to the south Asabaa stretches to the Garian-Mizda administrative boundary. The population of Asabaa is 6,912 and includes 22 tribes. Of these, the greater part are semi-nomadic but four tribes are engaged more exclusively in agriculture. The distribution of the Asabaa semi-nomads is fundamentally a reflection of the physical environment. Originally, they were pure nomads of the steppes but when they entered the Jebel, presumably from the south, they retained their old traditions, seeking to avoid the highly accidented areas of Garian. Thus, their settlements are concentrated on the plateau zones of the Jebel Garian, avoiding the western edge of the Wadi Zaret and the northern edge of the escarpment. Hence, environment

plays an important role in the distribution and movement of the Asabaa semi-nomads. Movement is very rapid both to the north and the south, utilising the former for cereals and the latter for pasture. Although the distribution of semi-nomadic settlement is unstable, it is generally considered that the zone of more permanent settlement is that occupied during the summer months. Many of the semi-nomads own small plots of land in this area, which in Asabaa is the northern section of the Mudiriyat. Here, the semi-nomads live for the whole summer in black tents, though recently some have settled semi-permanently in troglodyte dwellings.

Their economy is based on pastoralism augmented by shifting cultivation. Movement is directed southwards to the Ghibla, which provides favourable winter pasture. Again, the main wadis and their tributaries provide water resources. In fact, there are two movements. The first takes place in early winter, as temperatures fall and rainfall increases to give abundant pasture in the Ghibla. Hence, the pastoralists move to the deep south either with their own sheep or those of the other tribes. They can remain in the south until spring. In this season, temperatures increase rapidly whilst rain gradually dies out. Early spring gives good pasture but in April the oncoming drought forces the semi-nomads to retreat to the north. Temperatures here are slightly lower than in the Ghibla whilst aridity is better offset by the greater perennial watering points of the north. The flocks are left in the care of a few shepherds who seek for their charges the good pasture of the steppes of northern Asabaa. The rest of the people return to their places of normal summer

residence in central Asabaa. Here they harvest the fruit trees, and remain for the whole summer. (Plate 21).

Concerning shifting cultivation, the semi-nomads of Asabaa move to Gattis where they sow their cereals in Autumn. Some people, however, sow barley and wheat in plots on the Jebel or the Ghibla.

Rabta al Garbia and Rabta al Shargia.

These two tribes occupy the northernmost section of Asabaa. In fact their lands are at the foot of the Jebel in the Jefaran piedmont. This area undoubtedly belongs to the Jefara geomorphologically, but from the human viewpoint it is Jebelian. The settled population of these tribes is about 1,600. Each tribe contains two units. The two Ruabits generally live in stone constructed houses scattered over the parcels of land, the "Sania" or "Jenan". In other words, settlement is not nucleated except for the few tiny hamlets each consisting of the "jamah" or mosque and a few houses. The shops and market are located in the centre of Rabta al Garbia.

Rabta al Garbia and Shargia have one spring for each. The spring of the former is richer than that of the latter. These springs are the basis of the oases, in which the two tribes cultivate irrigated crops and trees. Date palms grow extensively in both oases whilst vegetables play an important role in cultivation. It may be said that the existence of these settlements is entirely related to water supply. Formerly, the inhabitants of the Jebel Garian drew water from these springs

whilst en route to Gattis or Garian. Occasionally, the inhabitants of Asabaa can draw water from Rubatis in drought years.

### Al Orban

The Mudiriyat Al Orban is the largest Mudiriyat in the Jebel Garian and has an area of 465 square kilometres. It lies to the east of the Jebel extending from Wadi Gan to the administrative boundaries separating Garian from Tarhuna and Orfella. To the north it is defined by the Jefara while southwards the area extends to Mizda.

The population of Al Orban, in which are found six tribes, is 5,232. Although the population is distributed fairly widely over the whole Mudiriyat, permanent settlement is concentrated in specific areas. Some tribes, for instance the Gmata, Azib en Ntatat and the Ulad Brek, are concentrated in the north and north-east. The Gmata, with a population of 2,042, formerly expanded towards Tarhuna, but later became settled within the administrative district of Garian. Their lands are considered the most favourable in Garian. The surface is less broken and slopes are more gentle than further west. Thus the Gmata is the most influential tribe, socially and politically in the Mudiriyat Al Orban. The Azib en Ntatat and Ulad Brek occupy the southeast of the Mudiriyat and their lands adjoin the Orfella. The central zone is occupied by the Jiaafra and their lands extend from the upper part of the Wadi Geddaf el Dam as far as the extreme southern portion of the Ghibla. Their settlements are widely dispersed over the whole area.

In Al Orban, the greatest single factor in the determination of settlement sites is the water supply, i.e. the springs and Roman cisterns. Each tribe has its own springs and cisterns, around which their settlement and camping ground are located. Thus, settlement is concentrated in the eastern parts of the Jebel, where the deep incision of some of the wadis, related to the zone of basalt extrusion, cuts the main aquifers and forms a series of springs along the wadis. Economic forces are also strong in influencing the concentration of settlement in the east. Trade between the Garian semi-nomads and the settled peoples of Tarhuna village and Beni Ulid exerts a significant influence. It is easier for the Gmata semi-nomads to visit the markets of Abbiar Miggi and Tarhuna than to visit the town of Garian which is separated from Al Orban by a zone of intense erosion. The old Gmata souk, Ain Wif, is now little favoured and is being replaced by that of Abbiar Miggi. On the other hand, the Azib en Ntatat and the Ulad Brek have the right to enter Orfella to buy and sell foodstuffs. But at present, there are certain political restrictions on the semi-nomads compelling them to look inwards with regard to ordinary marketing needs, because a new market has been built. Thus the old souks of the central part of Al Orban are growing in influence. (Plate 22).

Economic activity of the semi-nomads is based on pastoralism and shifting cultivation. The latter is of considerable importance as a supplement to the former, and there is small scale movement from the permanent settlement to zones of good winter

rainfall or cereal sowing, in particular in the Ghibla. This zone in Al Orban lies astride the water shed between the Wadis Soffeggen and the Geddaf el Dam. The wadis receive the floods of winter rainfall and the sêdiment in the valleys gives good land. Most of the families stay in the Ghibla the whole of the winter looking after the animals and crops. After the harvest, they return northwards to their traditional water sources where they stay the whole summer.

The pastoralists move in two directions: during winter they move to the south and in summer they return to the north. This movement is related to the fact that winter rainfall in the Ghibla gives rise to a fair vegetational cover and adequate pasture for the wandering flocks. Cisterns at the wadi bottoms give sufficient water for domestic purposes. However, these conditions no longer exist after spring, and the south becomes an area of great aridity, with high temperatures. The north with its less extreme heat and its perennial water resources is thus a magnet that attracts the tribes in early summer.

Transhumance is of greater importance and more widespread in this zone than elsewhere in the Jebel Garian. The tribes are nearer to being true nomads than those of the west. Formerly, the semi-nomads spread over the lands of Tarhuna and Orfella but at present, the tribes are restricted to the confines of Garian. This restriction on the old movement of these semi-nomads together with the establishment of schools in the Mudiriyat Al Orban has tended to settle semi-nomads.

### The Distribution of Italian Settlement

The Italian Government commenced the establishment of settlement in the Jebel Garian in 1933. This was part of the Italian attempt to create colonial estates in Libya both to develop their colony and to alleviate the growing pressure of population on resources in Italy. In the Jebel Garian, the plan was to develop an estate concentrating on tobacco cultivation. Several reasons governed the Italian selection of Garian. This area has the best rainfall both in volume and reliability in Tripolitania. The average reaches 10-16 in. per annum. The temperature extremes of the maritime zone were mitigated by altitude. Summer maxima in July and August reach 33.3°C. and 31.8°C. respectively. In fact, these conditions were in several ways more favourable than those of Sicily where many of the Italians originated. Hence, the Government encouraged the development of Garian and helped young Italians to establish a second home in the Jebel Garian.

In 1933, about 500 Italian farmers came to the Jebel which was given to them by the Italian Government. The organisation of settlement was in the hands of a Government agency known as A.T.I. (Azienda Tabacchi Italiani).

The settlements were concentrated in the central part of the Jebel in the Mudiriyats Beni Daud and Beni Nser. Topographically, the area chosen was the plain that extends from the north of the Mudiriyat Beni Daud and Beni Nser as far as the northern part of Beni Khalifa. Italian colonisation is centred at Tigrinna which lies to the east of the main Jebel road. The land on this side

of the road is more gentle and less broken with a fine cover of Quaternary material. To the west, slopes are steep and the area is one of rocky hills, narrow depressions and wadis. Thus the Italians concentrated their development projects on the east of the road. They used these lands which required less capital investment in development. The soils are remarkably deep and fertile being rich in organic material. The actual area selected lies to the east of the road as far as Tegassat, Sgaif, Kammun, Beni Yahya and Ghasat. The Italians only utilised part of this area. The rest was planned for later development, but the war prevented this from being completed. Further, the area was limited in the Mudiriyat Beni Khalifa for several economic and political reasons: the hilliness of the terrain, and the fact that many of the ancient Berber villages and a considerable proportion of the rural population lived in this area.

#### GARIAN TOWN

Garian town is centrally situated between the Jefara and the rest of the Jebel Garian, between Arab steppe and Berber mountain. It thus connects the Ghibla with the coastal zone, and is the main centre for communication between north and south. Historically, Garian was a station for the caravans that came from the coast either towards West and Central Africa or towards Nalut and Ghadames. (8) Garian is still important as the most accessible of the Jebel towns with regard to routes towards the Jebel Nefusa, Ghadames and the Ghibla (i.e. to Mizda, Brack and Sebha). Further, it is linked to Tarhuna by a rough motor track. It is thus

possible to see Garian as the main centre of the whole Tripolitanian Jebel (Fig. 30).

Again the site of Garian town is important with regard to surrounding villages and settlements. It forms the means by which the tribes of the Jebel Garian can communicate with the outside world, apart from being the local market and focal point of the region.

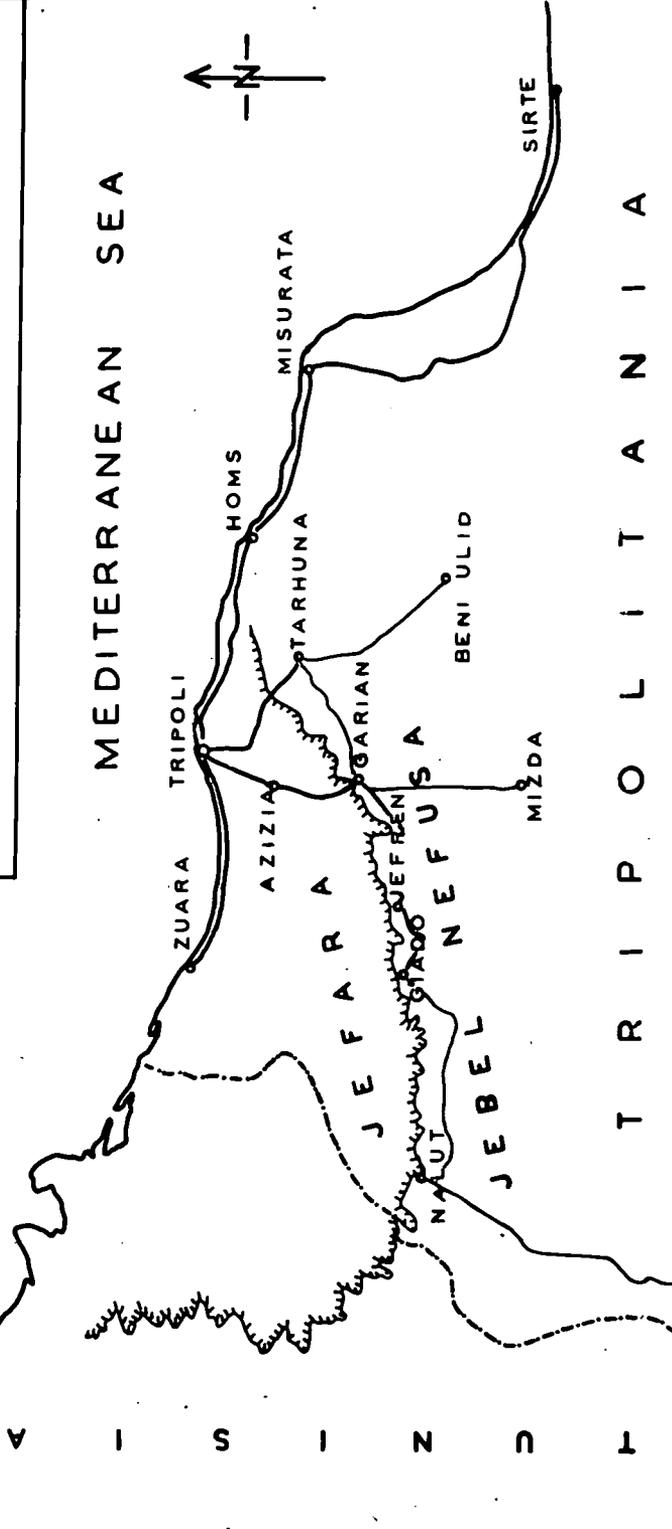
The town is situated on the second escarpment, formed by the Garian limestone. This escarpment, with a general level of 717-727 metres above sea-level overlooks the Ain Tobi plateau which is one of the most fertile areas in the Jebel. In addition, it adjoins the lowlands of the Jefara to the north-west. Thus the site overlooks the whole Jefara and the various isolated hills that are found in the front of the Jebel scarp. Towards the south and south-east, the land slopes down from an altitude of 717 metres at the scarp to 715 metres at Tigrinna village, 614 metres at Cammun and 660 metres at Ntatat. But the land to the south-west is highly accidented, containing many rocky hills, depressions and deep wadis such as Wadi Arbaa and its tributaries. Wadi Tegassat forms the western confine of the town. This wadi contains three large perennial springs, whose existence favoured the establishment of a settlement. Here Garian originated and grew.

#### Garian under the Turks

Before the Turks took over control of Libya in the sixteenth century, it appears that Garian was a small village with perhaps a few shops and houses catering for the caravan traffic. It may

Fig. 30.

# THE POSITION OF GARIAN



— MAIN ROAD, USUALLY SURFACED, MOTORABLE  
 - - - SECONDARY ROAD, SURFACED IN PART, MOTORABLE



have achieved some significance in Roman times, but there is little recorded evidence to justify this fact. The Turks constructed a large fort - Gasr el Turk - on the summit of a cliff that lies to the west of Garian town, a good defensible site that further overlooked the Wadi Tegassat and the main caravan routes along it. The fort was both a military and administrative centre. Turkish officials resided there, with the garrison, and were thus able to ensure that taxes and dues were extracted both from the inhabitants of the Jebel and from the caravans. The fort was also the headquarters for the suppression of the numerous revolts that broke out during the period of Turkish control.<sup>(9)</sup>

At this time, Garian itself was very small. It consisted of the Gasr al Turk, with its many large rooms and typical courtyard, an ancient mosque, and a few whops. The population was mainly concentrated in the various troglodyte villages and in fact there was little need or reason for Garian to grow in size, given the conditions of this period.

### The Growth of Modern Garian

The Italian invasions wrought revolutionary changes in Garian. The Jebel Garian was finally occupied in 1922 and almost immediately the Italians started to construct buildings for administration and for their garrison. At first, building was concentrated in the east but subsequently it developed southwards and then along the main Garian-Tripoli road. Along both sides of this road are to be found shops, houses and schools(Plates 23, 24, 25, 26).

Modern Garian is in fact a legacy of the Italian era. In some ways, it may be compared to the central areas of many

European and American towns in as much as the town is little used as a dwelling place but rather as a place of work and business. The bulk of the population are administrative officers, foreign teachers and Italian families. The businessmen who own shops and cafes in the town live in fact mainly in the village of Tegassat, and the town is largely deserted at night, despite the extensive buildings.

According to Agostini,<sup>(10)</sup> the population of the old town of Garian (Tegassat) was 1,800 inhabitants in 1917. The present population is 3,112. Thus the growth of the population within 42 years is 2,312 inhabitants. This increase is due to two factors: emigration of the rural people to Garian and natural increase. After 1922 there was a large influx of Italians, but later as a result of the war and subsequent plans for independence, many of those Italians left. There are now only 717 Italians, most of them own either shops or farms. Moreover, in 1913 there were about 300 Jews in Garian town who increased to 500 by 1927, but they left the town in 1949 during the establishment of Israel state.

There are two distinct types of settlement within Garian town: the old troglodyte dwellings of Tegassat, the original nucleus of Garian, and the modern buildings of the Italian and post-Italian period.

### Tegassat

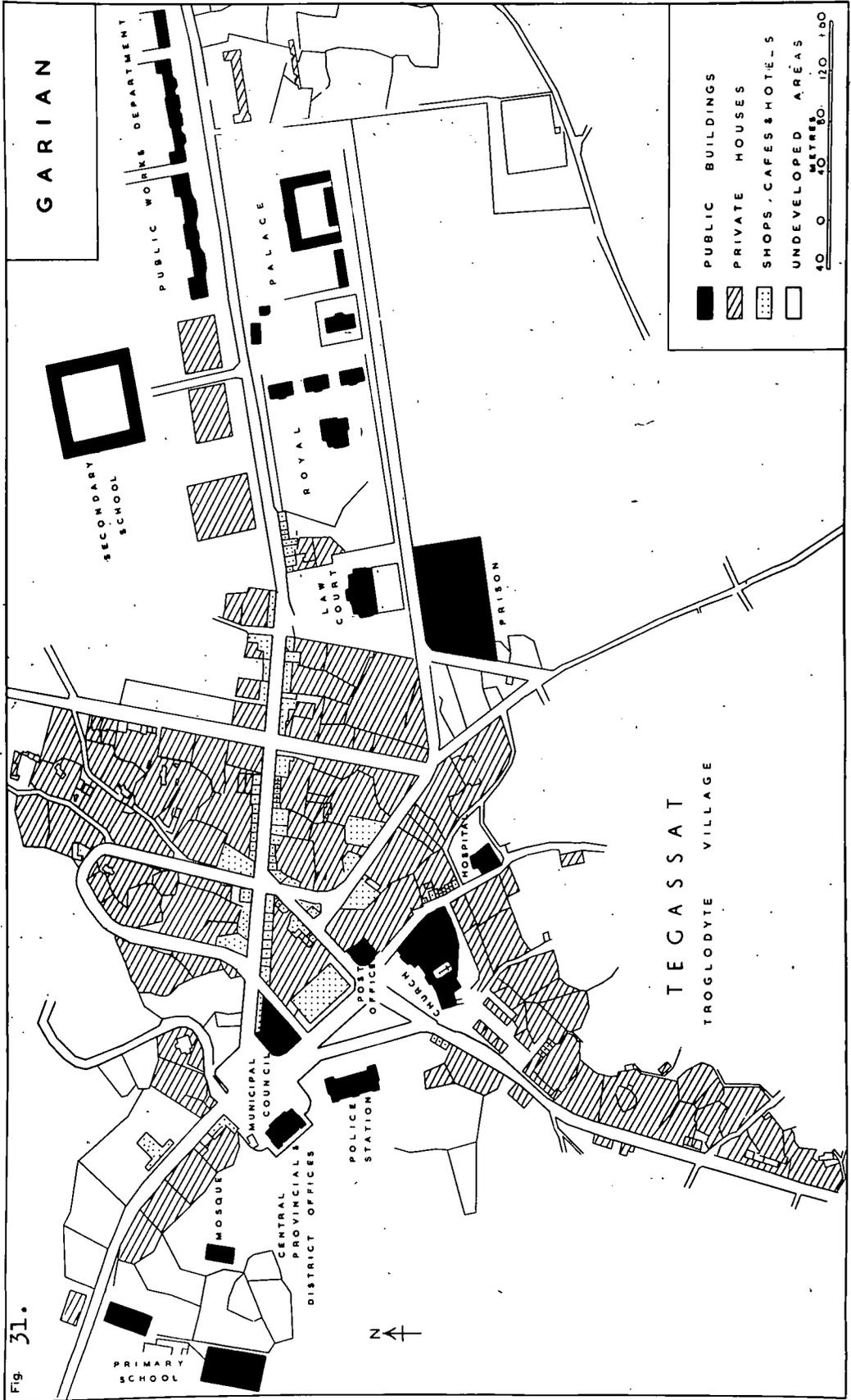
Tegassat is a small village, situated to the south-east of Garian town. It is triangular in shape with its apex to the

north and base to the south. The larger Tegassat Berber tribe live in the numerous troglodyte dwellings in the village. The general morphology of the troglodyte house is identical in all the cave dwellings of Tegassat (See p.134,135).

Tegassat is a residential village. Some of the inhabitants possess small gardens in the vicinity but the large land- and tree-owners live outside the village. The village is entirely dependent on Garian for most of its services. There are, however, four mosques, a primary school for girls and a few shops.

Modern Garian (Fig. 31).

The settlement morphology of the modern Garian town is regarded as a good example of the modern type of Italian planning. From the centre of the town, the main roads depart to the east and to the south. The main administrative buildings and offices are concentrated in the centre of the town along these roads; the Garian District Office, the Central Province Office, the municipal offices, the electrical power station and the main market of the town. Along the whole of the main road to Tripoli within the confines of the town are numerous shops and offices and cafes as well as Government building and schools. The numerous cross and side streets are similar on a smaller scale. Further expansion of Garian will be to the east; in fact the original Italian plans showed that their future development was to be towards the east, where a considerable area of flat land suitable for building requirements is available. Towards the south of the town are found the old houses of the few local people that live within the



confines of the municipality. These stone buildings of the traditional Arab pattern contrast markedly with recent Italian and modern houses that occupy the bulk of the town.

A comprehension of the functions of Garian must be based on its position as the principal centre of the Jebel Garian itself, and as the economic, political and social contact between the tribes and the outside world. The main economic function is that of marketing. It is the largest market in the Jebel, dealing in foodstuffs, agricultural and pastoral products, instruments and tools, and other essential needs. The market is the chief means of exchange between nomad, cultivator and merchant. Although there are several smaller markets in the Mudiriyats Beni Khalifa, Asabaa and Orban, they are merely either secondary centres and satellites for Garian or small souks dealing in the exchange of food between tribes. The only real exception to this pattern is found in the Mudiriyat Orban. Here, the semi-nomads tend to favour the more accessible markets of Beni Ulid or Tarhuna, as Garian is about 45 kilometres away. Moreover, the people who live in Rabta al Garbia and Rabta al Shargia suffer from inadequate transport facilities as there are no buses available to take them to and from the market of the town. Consequently, they have to travel a distance of over 32 kilometres either using animals or walking, despite the fact that both Rabtas supply the townspeople with vegetables (they are regarded as second only to Tripoli in production of vegetables). The distance of the inhabitants of Mudiriyats Guasem and Asabaa

from the market is 16 kilometres, but the people who live in Mudiriyat Beni Khalifa have to travel only 8 kilometres. The people of the Beni Nser could easily either walk or get a bus to reach the market only four kilometres away. So, the market in fact influences the people of the Jebel Garian as a whole. But the economic advantage differs according to the remoteness of the market from the different Mudiriyats.

The numerous shops along the main road cater for the day-to-day needs of the population, as the market is open for only two days in the week, Thursday and Sunday. Centres for delivery of goods to the shops in the outlying villages are found in Garian, as well as the head office of the Esparto Company is found at Garian, which is thus the principal centre for collection and distribution of esparto.

Local industries are in fact limited to the collection and transport of tobacco and esparto and the primary processing of certain agricultural products, such as cereals and olive oil. However, one industry that is developing is that of tourism. At one time the town was a weekend resort for Italians living on the coast. Now the main attractions of Garian are the troglodyte villages, the wonderful panoramic views from the Jebel scarp and the notoriety of the picture of "the lady of Garian". Much of the tourist traffic is limited to excursions from the coast but with the development of the Garian Hotel and increased advertisement tourism could achieve much greater dimensions.

As the administrative centre of the Jebel Central province,

Garian contains the head offices of Government departments controlling both Garian, the Jebel Nefusa, Mizda and Ghadames. On a lower level is also the centre of Garian district with a certain amount of duplication of offices.

Garian contains the principal secondary school of the area, as well as providing primary education for the surrounding villages. Further, it contains a mosque, a cinema, a club and various bars and cafes.

Communications are based first on the main roads and on the better tracks, and secondly on the numerous caravan and camel tracks. The main road links Garian with both Tripoli and Yefren. Another road departs from the south of the town to the agricultural area in Tigrinna, and is thus important for the farmers in this area. A third road departs from the north-west of the town to descend to both Rabtas, Gaths and the old railway station at Vertice. Two buses daily connect Garian with Tripoli, and a third goes to Yefren and the towns of the western Jebel.

Garian may thus be seen as a small regional centre providing for the economic, social and political needs of a large area. It is also the means by which the tribes can communicate with the outside world. The future of the town is based on the expansion and development of these activities. It appears that in future years Garian will be not only the educational centre for the whole escarpment but also a centre of tourism and tobacco growing. The prospects appear to be bright and the fundamentally good position of Garian between plain, mountain and Ghibla ensure that

given favourable political developments, the town will expand.

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CHAPTER IX

AGRICULTURE

Historical Résumé

The early history of the mountainous areas of Tripolitania commenced from the Phoenician occupation. The country as a whole was inhabited by nomadic tribes with their flocks and a certain amount of cereals must have been produced. The Jebel Nefusa and the Jebel Garian were covered by forests. The forests generally were fairly dense on the Jebel slopes, and towards the south extended for some ten kilometres, becoming more spare and patchy, and finally giving way to the desert grazing and scrub. This forest in the region of Garian, Tarhuna, Kussabat and Homs was well developed and full of good timber.

The Phoenicians took little interest in the interior of the country, especially the mountainous areas. Their agricultural efforts were concentrated only in introducing olives and some fruit trees in small areas along the coast. More and more interest was paid to the country and its development as Carthaginian trade became submerged by Rome. During the Phoenician era, the nomadic people of the Jebel Garian commenced the clearing of forest and sometimes burned part of forest in the dry summer in order to destroy wild animals and sow cereals. But the nomads generally retained the forest for summer grazing in order to benefit from its value for shelter, shade and protection from the desert.

Polybius<sup>(1)</sup> records that King Massinissa played a valuable part in the development of land in Numidia (it included Tripolitania) which was generally regarded as unable to bear crops. Static agricultural development was difficult because of the existence of nomadic grazing, and also the depredation of wild animals. He gave more attention to providing security, which was in fact essential for land development, assuring the rights of land tenure, and giving the farmers protection from the tribesmen of the interior. Massinissa's work was continued by his successors Jugwitha and Juba.

However, the development of agricultural land was very limited in the Jebel Garian during the rules of King Massinissa and his sons as the mountain was covered by forests. The Phoenicians paid little attention to these mountainous regions. The nomadic tribes who were spread over the Jefara plain used to come up to the Jebel for hunting wild animals.

When the Romans came to Tripolitania in 145 B.C. their initial efforts were largely concentrated on increasing wheat production. They paid little attention to planting olives and vines because Tripolitanian oil and wine were never as good as that produced in Italy, Spain and Greece. Moreover, vineyards were destroyed to make room for wheat.

In the 2nd century, Rome fostered the development of the resources of each Province of Tripolitania. It commenced to encourage the people to plant olives and vineyards. This change

in agricultural policy may be ascribed partly to the decline in the fertility of the soil and to a growing shortage of wine and oil in Rome, as had been the case with wheat supplies sometime before. So the agriculture extended southwards in Tripolitania, and the Emperor Septimus Severus (193-211 A.D.), who was born in Leptis Magna, organised the defence of the country against the Berbers. Consequently, the planting of olive trees in Tripolitania as a whole developed widely ( Fig. 32).

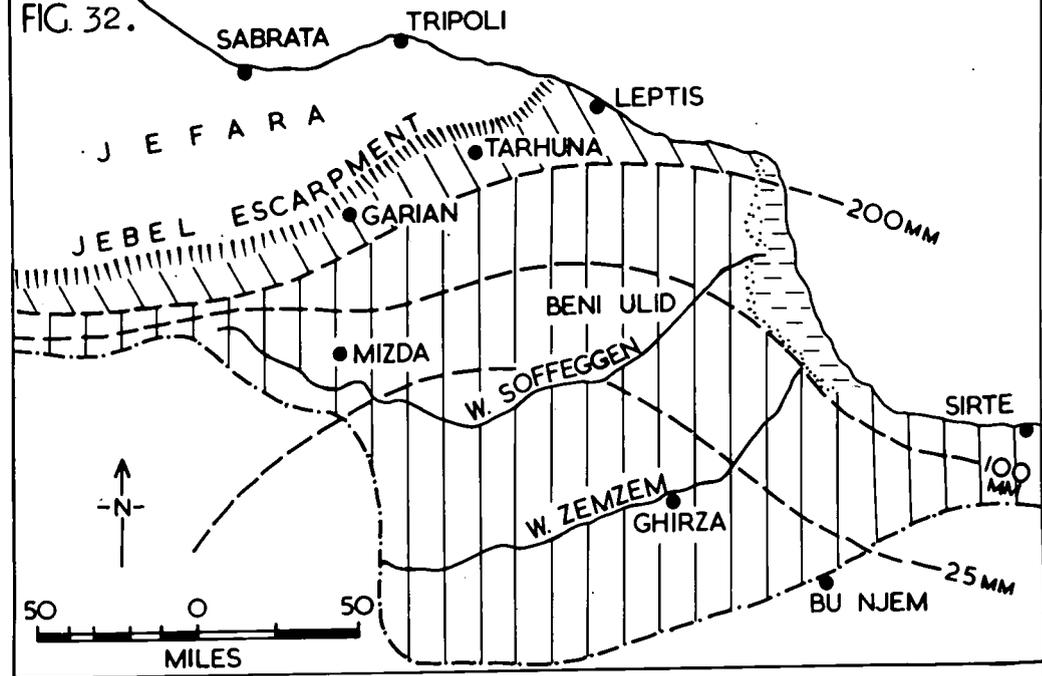
The Jebel Garian as a part of the Tripolitanian escarpment, was influenced by this agricultural development. There is much evidence of the remains of Roman farms and oil presses throughout the fertile areas of the Jebel.

In addition, the rights of tenure, both for native and Roman land-owners, were respected and agriculture was developed to a higher level than that of nomadic herding. Moreover, the Romans paid great attention to the arresting of soil erosion with masonry dams across the valleys as for example in Wadi el Guasem and Wadi Mejenine to obtain water for agricultural purposes.

In the 7th century A.D. the Arabs overran Libya, and caused a serious decline in agriculture. Nomadic life developed once more. The Berbers who used to live in the whole coastal zone and Jefara withdrew to the mountainous regions such as the Jebels Nefusa, Garian and Tarhuna. The Berbers practised cultivation on the slopes of the wadis on terraces and the plain areas. They used to sow wheat and barley over the Jebel lands, and at the same

# ANCIENT LAND USE & SETTLEMENT IN TRIPOLITANIA AFTER GOODCHILD

FIG. 32.



-  AREA OF ANCIENT OLIVE CULTIVATION IN HILLS
-  AREA OF ANCIENT CEREAL CULTIVATION IN FAVOURED WADIS
-  APPROXIMATE LIMIT OF ANCIENT SETTLEMENTS
-  RAINFALL ISOHYETS

time they paid great interest to olive and some other fruit trees. They benefited greatly from the existence of springs in the bottom of some of the wadis such as Wadi Arbaa, Wadi Gan (near the Slahat tribe) and Wadi Torshin. They were accustomed to the use of irrigation methods especially during the summer.

The Jebel Garian in the beginning of the Arab conquest was fully controlled by the Berbers. But the situation changed suddenly as soon as the Beni Hilal and the Beni Suleim entered Libya in the 11th century. Those nomadic tribes destroyed the last traces of the ancient agricultural prosperity. Some of the Arab tribes came up to the Jebel and dominated the whole eastern part of the Jebel Garian as well as the southern section. The Berbers were therefore in an isolated position. The Arab tribes practised their nomadic life, wandering with their herds from one place to another. Some tribes settled permanently in the Mudiriyat Al Guasem, where water resources were available near the surface; they used it to irrigate vegetables. Arabs settled in two other oases namely Rabta Al Garbia and Rabta Al Shargia, where they used spring water for domestic and agricultural purposes.

At the end of the 16th century the Turks occupied Libya. Their occupation did not mean any great changes in agriculture. On the contrary, the situation worsened as a result of the domination of Arab system of the Beni Suleim and Beni Hilal. Those tribes maintained their own traditions practising shifting

cultivation and a pastoral life. They never allowed the Berbers to go down to the Ghibla or Gattis for sowing or grazing. The Turks paid no attention to the mountainous regions. They concentrated their efforts on getting taxes from the inhabitants. As a result, sedentary farming on the Jebel was restricted by those Berbers who had the opportunity to cultivate their own lands on the plateaux or the slopes of the wadis.

In the 18th century, the Karamanlis took over the whole of Libya, but in the 19th century a second Turkish occupation took place. The Turkish administration during the rule of Ibrahim Pasha made some efforts to encourage the planting of olive trees over the mountainous zones.

When the Italian took over Libya, they could not commence development of the Jebel Garian before 1933, because of local resistance. Later on, they started serious development of cultivating lands and the establishment of demographic settlements. The basis of Italian agricultural activity was the encouragement of tobacco cultivation on all the fertile land. This was carried out by A.T.I. (Azienda Tobacchi Italiani) under the jurisdiction of the Italian State Monopoly. The A.T.I. confined its operation to a colony located at Tigrinna to the south of the Garian town.

Since independence, the Government has paid great attention to developing the cultivable lands over the Jebel. The semi-nomads of Al Asabaa, for instance, have started to plant various trees in their own cabila lands, whilst the semi-nomads of Al Orban

maintained their pastoral activity.

### POSSESSION AND OWNERSHIP OF LAND

In the Jebel Garian, land is divided into five categories:<sup>(2)</sup>

1. "MulK", or property held in full ownership by private persons.
2. "Miri" or public property belonging to the state.
3. "Wakf" or land alienated in mortmain not liable to transfer.
4. "Matroke" or land made free for public use.
5. "Mawat" or land not cultivated, or waste land.

1. "MulK" land is the most outstanding feature among all the tribes of the Jebel Garian. Some members of each tribe own plots of land which differ in size from one person to another. The average size of each individual property ranges from one quarter to half of a hectare, but is invariably fragmented. Parcels of land are very small. The reason is the system of inheritance. On the death of a Moslem, after the funeral expenses have been met, his debts settled and the legacies and bequests made, the remaining estate is divided among his heirs, some of whom have a reserved share. There is in fact no limit to the subdividing of an estate however small it may be. Fruit trees are also divided, and one tree can belong to many people.

The Italians did not convert the Islamic legislation which was previously accepted by the Turks. Thus the system of ownership rights and land disposal remained. A person who owns a plot of land, whether in his own tribe or in another tribe, can exercise his rights and he can supervise his property. So the members of the cabila retained these traditions from one generation

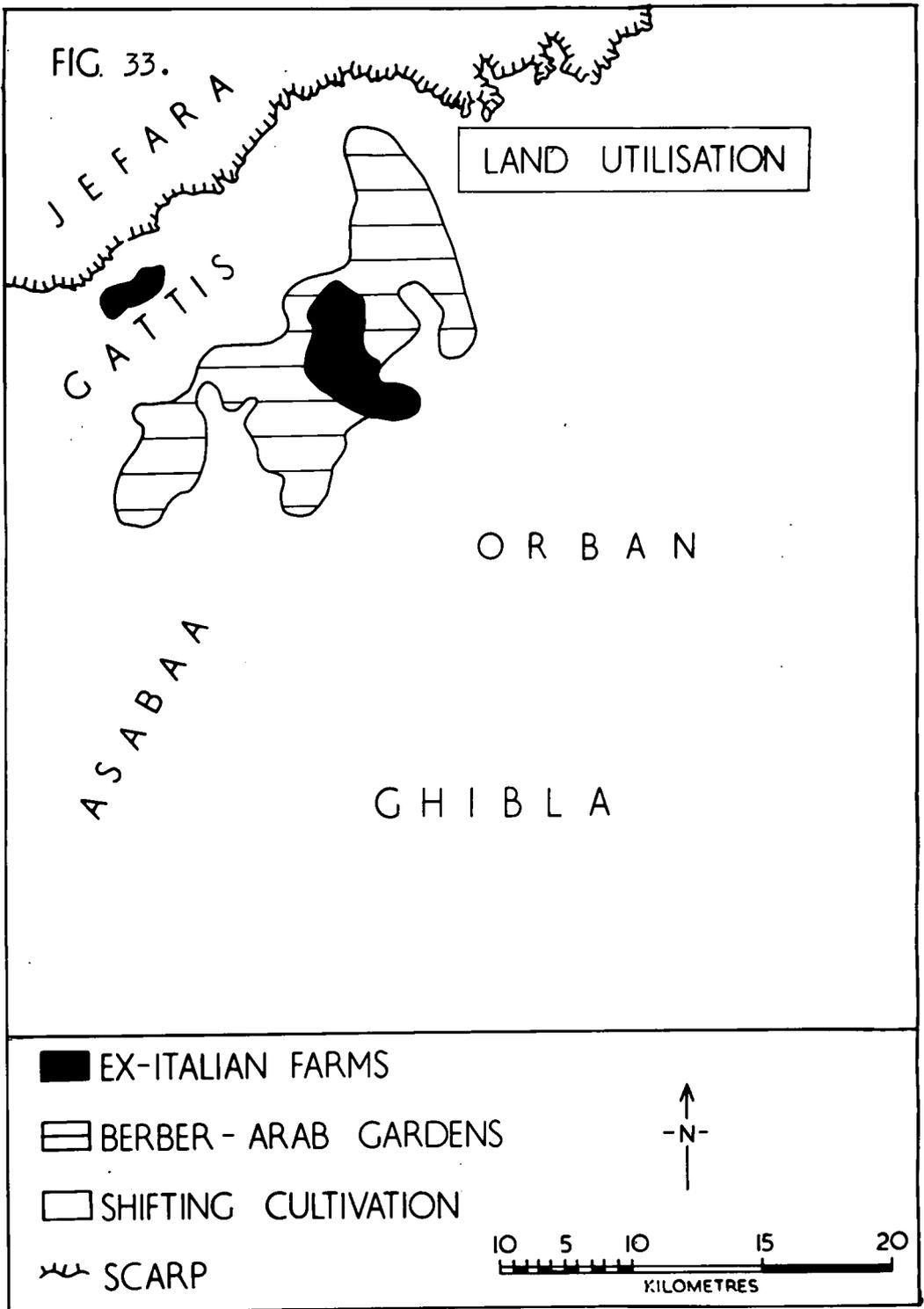
to another. As a result of inheritance, it is very difficult to define the properties of all the owners, especially when they have not registered their lands. With every generation, individual lands become smaller and more difficult to survey.

However, the mulk lands in both Mudiriyats Beni Nser and Beni Dand were confiscated by the Italian Government and given to Italian settlers. The owners were dismissed and expropriated their properties. The sedentary peoples in the Mudiriyats Beni Khalifa, Al Guasem, Al Asabaæ and Al Orban were not influenced by Italian agricultural activities because of lack of time and money. Those inhabitants retained their own properties.

Private holdings in the Mudiriyat Al Guasem and Beni Khalifa consist of small plots in the cabila itself as well as some land of the Ghibla and Gattis. Some private holdings in both Al Asabaæ and Al Orban contain 200 hectares. The size of holding differs from one person to another. For example, a large holding in Al Guasem is 60 hectares and in Beni Khalifa up to 30 hectares. In the Mudiriyat Al Orban, where pastoralism still prevails the private land of each member of the tribe is very large, so that it may be difficult to define each private land without a survey.

Gattis land This land is generally situated in the north-western section of the Jebel Garian and it extends from the foot of the Garian escarpment as far as the road which departs from Azizia to Bir Al Guem. This terrain is very extensive and is estimated to be 80 sq. kilometres (See Fig. 33).

FIG. 33.



The Turkish Government during its administration of Libya in 1882 sold this land to the inhabitants of Garian for cultivation, because the Berbers had insufficient cultivated land on the Jebel. However, all Garian tribes own plots in Gattis. The cultivators go down during autumn to sow cereals or during early summer to harvest them. The utilization of cultivated land depends on the holder who has a right to sell his land or rent it. Thus Gattis is regarded from this point of view as "Mulk" land.

2. "Miri" land, or communal land exists in the southern zone of the Jebel, to the south of both Al Asabaa and Al Orban, and is locally called "Ghibla land". It is estimated at 115 square kilometres. On the northern edge of the Ghibla, there is found the main watershed. From this, deeply incised and tortuous wadis flow towards the north with, however, considerable deposits of alluvium along their courses. To the south, the wadis are more gentle being wide and fairly flat but with a well defined "Lit mineur". They are encased between stretches of flat or gently dipping denuded plateau surfaces except where the volcanic outcrops have given rise to more rugged features. The Ghibla is used for winter pasture and the shifting cultivation of cereals particularly in the wadis where a part of the winter rainfall is retained in the sub soil.

Thus the cultivators of the Beni Nser, Beni Khalifa, Al Asabaa and Al Orban have full rights to utilize this land either by cultivation or pastoralism. This land right was given by the

Turkish Government to the Garian tribes in 1882 at the beginning of the second Ottoman occupation, and has therefore been used by the people for a long time. Later on, the semi-nomads of Al Orban objected strongly and did not allow Beni Khalifa and Beni Nser to utilize their land rights. Consequently, fighting between Berber cultivators and Arab semi-nomads broke out. Therefore, the Tripolitanian Government prevented both Arabs and Berbers from utilizing Ghibla land either for sowing cereals or grazing animals.

3. "Wakf" land occurs in all tribal lands of the Jebel. Normally small parcels, wakf can be within or without. The utilization of this land is very limited and the total area is unknown.
4. "Matroke" land is found in large areas in the western part of the mountain and in all undeveloped areas in Beni Daud, Beni Khalifa, Beni Nser, Al Guasem, Al Asabaa and Al Orban. It does not belong to any particular holder; matroke land is normally owned by the whole tribe. No one from another tribe has the right to use this land at all. However, it is possible for any member of the tribe to utilize it. In both Beni Daud and Beni Nser, the Italian Government entirely controlled this land in order to develop it for agricultural purposes. In the rest of the Mudiriyats such as Al Guasem, Beni Khalifa, Al Asabaa and Al Orban, the matroke land remains as before.
5. "Mawate" land is found in different places in the whole of the Jebel. This type of land normally consists of rocky hills or dry wadis which are generally unsuitable for agricultural

activities. It is easy to distinguish this land in all the rocky areas of eroded limestones in any section of the region. The soil was completely eroded from these hills. At present, the matroke land is increasing continually as a result of cutting of trees and over-grazing as well as torrential rainfall. Furthermore, dry weather during spring and summer reduces the vegetation cover and facilitates wind erosion. This phenomenon is dangerous unless the Government and people plant various trees in order to protect soils from going down to the bottom of the wadis. This type of land is noted in Beni Daud, Beni Nser, Beni Khalifa and Al Guasem. Soil erosion is not extensive in Al Orban or Al Asabaa, as the land has maintained its natural vegetation, and the mawat land is therefore not a problem.

#### SYSTEMS OF FARMING.

There are two types of dry farming in the Jebel Garian: Berber gardens and Italian farming.

Berber gardens. The dry Berber gardens are found widely throughout the Jebel. This type of dry farming depends on the quantity of rainfall and sometimes in specific zones either on wells or springs. The size of each unit of land differs from one place to another, but is generally small. The average may range between one quarter and one half of a hectare. These small gardens are found either inside the cabila land or on the slopes of the hills and the minor terraces.

(a) In Al Guasem, the dry gardens are found within the lands of all tribes with the exception of Kmashat which depend on irrigation (Plate 27). The cultivators in this part of the

mountain own patches of land within their own tribal areas. The maximum size of holdings reaches 20 hectares and the minimum is a quarter of a hectare. This is due to the fact that the Italian Government have not appropriated the cultivated land of this part of the Jebel. However, there is a strong connection between the distribution of settlements and the cultivated lands in Al Guasem. Agriculture flourishes where fertile land and water resources are available. Dry gardens generally spread over the whole Guasem plateau with the exception of the western section where the rocky hills form a zone which extends from north to south such as Caf Sdendu, Caf Ben Yekhlif and Bu Gannush (Plate 28 ).

Generally speaking, the dry gardens grow cereals and tree crops such as olives, apricots, almonds, vines, apples. In addition, they grow vegetables, but it must be borne in mind that vegetables require artificial irrigation. For instance, they are grown in Kmashat and Wadi Nakhle as the water-table is near the surface (Plate 29 ), but in the other tribes of Al Guasem, cultivators irrigate vegetables by obtaining water from their own cisterns. Moreover, the vegetables from these small gardens are normally for domestic purposes.

(b) In Beni Daud, the Berber cultivators own small cultivated parcels either on the plateau or on minor terraces in both Wadi Tegassat and Wadi Mgar (Plate 30 ). The Italian colonization (1933-39) concentrated its projects on the fertile zone in the Beni Daud, leaving the rocky hills, waste lands and wadi slopes

for the indigenous cultivators. Thus Ulad Ben Yaaghub, Cradna and Gasr Tigrinna tribes who are settled in the western section of the Beni Daud continued practising their primitive agriculture. They used to irrigate their own gardens in Wadi Mgar by major springs, but later, their own rights were appropriated by the Italian Government who decided to distribute water not for irrigation but for domestic purposes in Tigrinna village. In 1958, most of the Italians left the mudiriyat and their farms were taken by the Berbers.

(c) The system of farming is similar in Beni Nser; the only difference is that some tribes depend on irrigation: Zawiet Abd Al Mlack, Al Yaagib, Bu Ayyad, Dannun and Salahat. The other tribes depend on dry farming. The cultivated areas in the western zone are situated either on the slopes of wadis such as Wadi Arbaa or on the minor terraces such as in Abu Ayyad. In Dannun, the Berber gardens are found in the bottom of the Wadi Arbaa. Concerning Salahat, the major cultivated belt is found in the bed of Wadi Gan or its tributary (Plate 31). Thus the type of farming in all these areas is similar to irrigated orchard cultivation.

(d) In Beni Khalifa, the dry gardens are the dominant feature in the eastern zone of the mudiriyat where the most fertile zone is found in the Wadi Al Taffah and Wadi Njasat.

The cultivated lands of the western zone of Beni Khalifa are limited by the appearance of the rocky limestone hills. Thus the Tebadut tribal land is considered to be the only cultivated

area. Formerly, the cultivated land benefited from its vicinity to Wadi Torshin; at present the agricultural belt is restricted to minor terraces and small plots over the gentle slopes of the rocky hills. The Berber cultivators of Beni Khalifa rely entirely on their fruit trees, cereals and vegetables. In Wadi Taffah and Wadi Njasat, cultivation flourishes owing to fertility of soils. The major tribes who have settled in this zone are By Zayyan, Beni Wazir, esh Shamsa etc. (Plate 32).

(e) In Al Asabaa, the cultivated zone is situated in the northern section of the mudiriyat, whilst the rest is generally grazing land. Dry and irrigated gardens are found, the former among the semi-nomads whose dry gardens are located on the Asabaa plateau, whilst the latter are restricted to Rabta àl Garbia and Rabta àl Shargia.

The semi-nomadic farming consists of growing crops such as olives, almonds, figs and vegetables. Cereals are also grown either within the cabila land or on Gattis and Ghibla lands. The semi-nomadic gardens are similar to the Berber dry gardens; small parcels of land, surrounded by a wall of clay which also acts as a boundary between one garden and another. On the other hand, dry gardens are sometimes found in the bottom of the wadis such as Wadi Crema, Wadi Bebouk and Wadi Janiah. The semi-nomadic cultivators also utilize springs as for instance Ain Misca and Saniet Crema. However, the cultivation of trees by semi-nomads of Al Asabaa is concentrated only in summer, when they return from harvesting the cereals.

The irrigated gardens of Rabta al Garbia and Rabta al Shargia depend on springs which are found in both oases. The Arabised Berbers have cultivated dates, barley and vegetables for a long time (Plate 33 ). Irrigated gardens are more prominent in Rabta al Shargia, because the capacity of the springs is higher than in the eastern oasis.

(f) In Al Orban, agricultural activity is very limited, as the semi-nomads are more mobile and less settled. Nevertheless, there are a few dry gardens in the bottom of these wadis with high water-table springs. The major crop is the date and also grown are some varieties of vegetables which resist aridity. The small plots normally lie on natural or artificial terraces. Italian farming. Both the ex-Italian farming and Berber farming in general depend on rainfall. The main difference is that the Italian farms were more limited in size (Fig. 34 ); they range from two to five hectares. Moreover, the Italian farmer had to grow a certain crop, tobacco, in which they used more advanced agricultural techniques than the Berbers or the Arabs. In addition, the ex-Italian farms were controlled by ATI which had the right to supervise the whole production of tobacco. On the other hand, the ATI offered during the drought years every kind of help to the farmers including food and water.

About 356 demographic farms measuring 1457 hectares, were established in two Mudiriyats, Beni Daud and Beni Nser.<sup>(3)</sup> Today only about 10 percent of the demographic farms remain. Furthermore, there was a private concession of 300 hectares called



Gertsiani farm, but after the death of the owner half was inherited by his sister and half to the family of the <sup>ex-</sup>Prime Minister of Libya.

The chief crops of both the ex-Italian farms and the private one, as mentioned already, are tobacco, olives, fruit and vegetables. The farmer was allowed to grow a limited area of wheat. It must be borne in mind that the area which is devoted to tobacco is  $1\frac{1}{2}$  hectares per farm, i.e. three quarters of the total area of a small demographic farm. The animal labour for each farm is one horse. Livestock are not kept in the farm for fear of damage to the tobacco and the other fruit trees.

However, the establishment of this type of modern dry farming on the Jebel plateau and under special arid conditions requires heavy financial assistance. Therefore, the ex-Italian agency made great capital investments.

The success of the farms since 1933 in increasing tobacco production was due to the fertility of the soil, favourable climate conditions and continuous hard work of the settlers. Thus modern cash-crop farming must receive more attention both from Government and the settlers themselves.

The Italian agency ATI had decided to expand the cultivated areas in the plain zones of the Jebel. Moreover, the agency decided to develop all lands suitable for the tobacco production in order to encourage more Italian settlers. But the outbreak of the second World War put an end to the projects of the agency and its desire to control more cultivated lands in Al Guasem,

Beni Khalifa and Al Asabaa.

METHODS OF IRRIGATION.

Although agriculture in the Jebel Garian generally depends on rainfall there are certain areas in the mountain which rely on irrigation. There are two kinds of irrigation, the first from wells, and the second from springs. The Kmashat and the Slahat tribes draw water from wells, while the Rabta al Garbia, Rabta al Shargia, Abu Ayyad and Dannun depend on springs (Plate 34).

(a) As regards irrigation from wells, the water-table in both Kmashat and Slahat lies near the surface. The average depth of the wells is approximately 5-10 metres, and they number about twenty in both areas. The system of irrigated farming is similar to the system in the coastal zone of Tripolitania. There is one well in each garden or groups of small gardens. Beside each well there is a sloping ditch, puddled with clay so that a cow can move easily up and down to raise the water, which is lifted in a primitive skin bag or dal. The system, known as iabadah, requires an individual to assist the cow or other animal draw the water. This operation in fact is a tiresome task. If a Persian wheel or other pumping device were used, one or more animals could be attached to the device and used to draw the water without additional effort on the part of the worker except to see that the animals kept moving. When the water is raised from the bottom of the well, the dal opens automatically to pour water inside a small basin called mada. The water then

flows down to the jabia or tank. As soon as the water reaches the top of the jabia, the worker or jabbad opens a small hollow in a bottom corner of the jabia, so that water can flow out along a channel which distributes water over all the jadawil or small pieces of cultivated land in the garden. However, the operation of getting water by the dalu takes about six hours. The worker has to spend another six hours irrigating the various jadawil. Moreover, there are another group of secondary channels which have to be opened and closed to irrigate the jadawil.

By this primitive means, the cultivators of both Kmashat and Slahat can irrigate their own lands. It must be noted that the total cultivated lands are limited by the capacity of each well. Vegetables and dates are grown for domestic consumption as well as for the Garian market. Alfalfa is cultivated to feed cows, donkeys and horses.

In Slahat, the same methods of irrigation and crops exist in all the small gardens that are spread over the bed of the Wadi Gan. Unfortunately, at the present time most of the Slahat wells are drying up owing to the excessive use by cultivators. Thus the activity of the farmers is being stopped by lack of water.

(b) In other areas such as Dannun and Bu Ayyad, irrigation depends on water from springs. Here crops are grown in small gardens on the wadi floor. These are irrigated by simple gravity flow down from springs located on the wadi sides. The

gardeners then channel this water over the whole area of the wadi floor. Every gardener has the right to irrigate his garden or janan at a particular time in the week. This prevents excessive competition between neighbours; a gardener not being allowed to use water when it is his neighbour's time. Some irrigated areas are dependent on rainfall. These are found on the wadi sides where the cultivators generally use a mound of clay and pebbles as a dam to prevent rain from flowing down to the wadi. They consequently make full use of it for their own land.

The success of crops in both ABu Ayyad and Dannun depends however largely on the capacity of the springs for the lands irrigated by rainwater are small compared with the plots on the wadi floor. In years of drought not only are the springs at a low level through lack of rainfall but also extra demands are made on them. In these years neighbouring Berber tribes, such as Bu Zayyan, Mgarba, Tebadut etc. come to ABu Ayyad and Dannun springs to obtain water, and so the spring cannot be utilized for agriculture.

In the Mudiriyat Al Asabaa, there are four springs: Taghnet, Om al Maarof, Ain Hasnun, Rabta al Garbia and Rabta al Shargia. The two latter are the most important springs in the whole Jebel Garian. The Rabta al Garbia spring is situated to the south eastern section of the oases. Its capacity ranging from 1500-2000 litres an hour is higher than Rabta al Shargia spring. The spring water runs from the eastern part of the oases through a

series of channels and slowly flows to the western part, where the water spreads over all the small gardens or swani.

However there is a specific method of distributing the water in the cultivated lands of the oasis. The local system of distribution of the spring water guarantees every gardener that his own needs of water for irrigation purposes will be provided. The operation continues day and night. Consequently, the cultivated lands are divided into many groups of swani, between each of which there is a main channel. There are a series of secondary channels along which water flows to the individual gardens. The local tribal tradition forbids anyone to utilize any additional quantity of water. One unfortunate factor is that there is no system of drainage and hence the cultivated land has become saline, as a result of the deposition of mineral salts in the soils.

The main crop is the date palm which is very successful in these oases. Vegetables grow well, but the absence of drainage affects some vegetables such as green pepper and tomatoes.

In Rabta al Shargia, the eastern oasis (Plate 33, there is one spring and two wells, which are utilized in the same manner as elsewhere.

In Al Guasem, there are also springs, most of which flow only in winter and are only used for domestic purposes. The two most important ones are in Bu Gheilan (Plate 35, the larger one lying to the west and the small one to the east. The ex-Italian Government has built a basin near the major spring in order to maintain

and control its water. The main use of this spring is to irrigate the small plots of vegetables. Rahba and Abgar tribes monopolise these springs for agricultural and domestic uses.

### ROTATION OF CROPS

There are two types of rotation practised in the Jebel, one for winter crops and the other for those of summer. The former involves cereals and vegetables such as cabbages, cauliflowers, carrots, turnips, spinach and lettuce. The latter involves tobacco, peas, tomatoes, green peppers, broad beans, onions, potatoes and tree fruits.

The rotation of cereals is very simple since the sedentary cultivator divides his land into two parts, one for wheat or barley, while the second is left fallow. In the next year, the cultivator sows wheat or barley in the fallow land. Poor people who own small plots of land, frequently cultivate them every year, but naturally the system of leaving land fallow produces much better yields. Biennial rotations are used on the plateau lands, but in the case of the Gattis land, both semi-nomads and Berbers utilize their own individual lands every year. This is due, on the one hand, to the lack of arable land and on the other to the fact that the Gattis lands normally obtain new soil as a consequence of annual wadi deposition. Thus in this zone fertility is annually renewed and so it is very favourable for growing of cereals.

### Fertilizers and Manures

Most of the Jebel soils are fertile and can give high yields

in case of occurrence of sufficient quantity of rainfall. Therefore, most of the Jebel farmers use manuring only for vegetables, in order to maintain the high yield of such crops. Inorganic fertilizers are used extensively in the ex-Italian farms which are devoted to growing of tobacco, but the Berber farmers use only organic fertilizer. Animal manure is available in quantity in the Jebel where the animals belonging to the farmers are kept for most of the year notably camels, horses and donkeys. Sheep and goats are mostly kept out of their own cabila land.

The method of preparing the manure for use is to sink the brought manure into a pit of some two or three metres' depth and leave it for a time. After three or four months the manure is at its best for use in the gardens. However, in the ex-Italian farms, the manure is not to be used for tobacco. The farmers are advised to use the inorganic fertilizers which do not harm this sensitive crop.

### TREE CROPS.

#### (1) Olives

The olive is one of the most important crops in the Jebel Garian, as it is grown over the whole region despite concentration in specific zones. It is generally well adapted to the soil conditions and low rainfall; it can resist wind and high temperatures and its cultivation is relatively simple. The inhabitants of the Jebel plant olives in the form of cuttings which are placed in the bottom of holes about three feet deep. Under this method, the trees get a good start and develop earlier than in the case of seedlings.

Garian olives are very ancient (Plate 36 ); some of them are several hundreds of years old. Naturally, there is strong reason in favour of following local practice which is based on centuries of experience. The Italians, however, adopted a different method of planting. They imported young seedling trees from Tuscany, probably on account of difficulties in obtaining sufficient cuttings of the local varieties. However, it can be seen already that the local varieties are more resistant to drought than the introduced types.

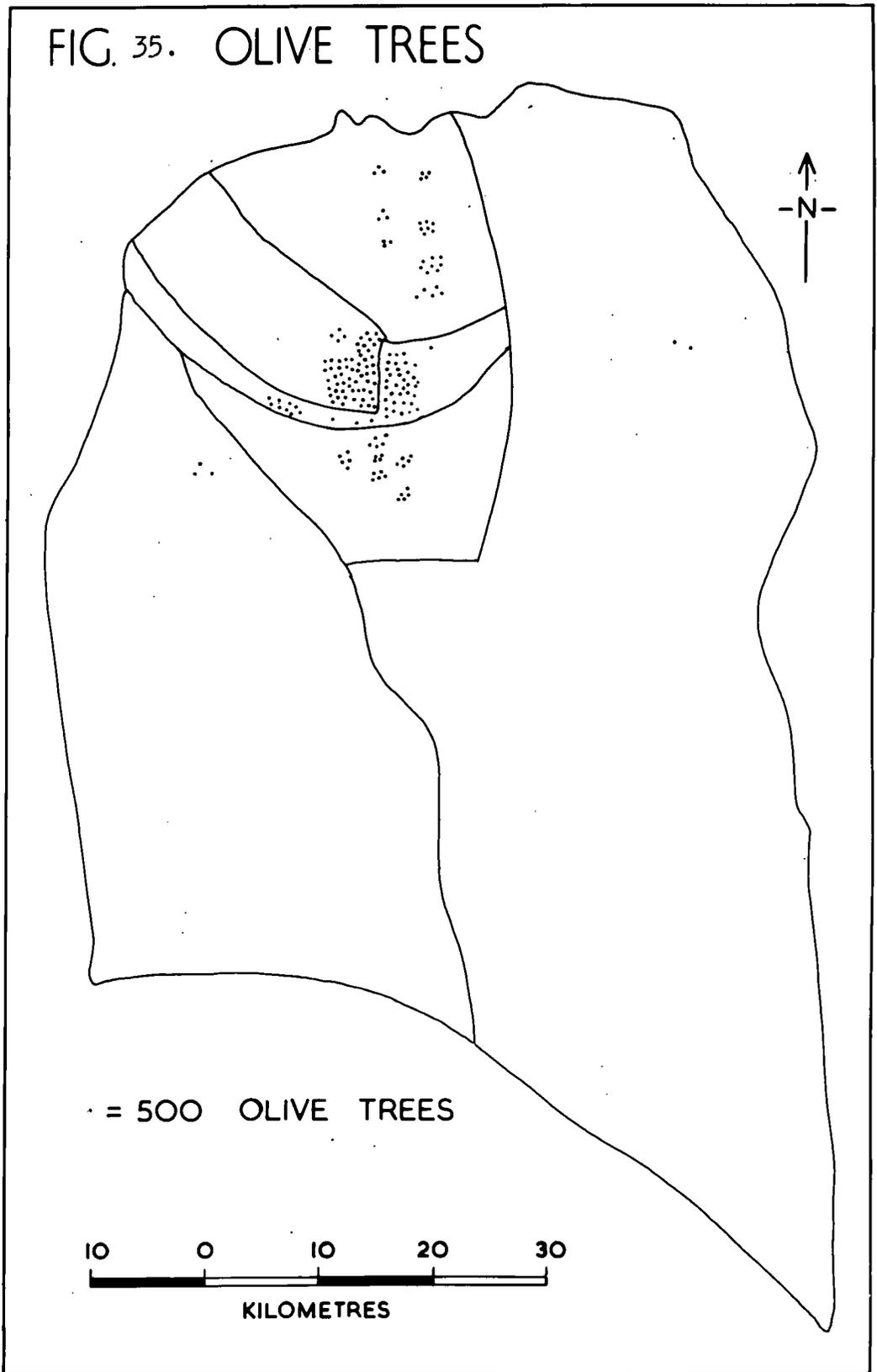
The local varieties of olive are Rasli, Gargarshi, Zarsi, Futuri, Chemlali and Hammuri (mostly planted during Roman and Turkish times), the new varieties imported from Tuscany are Frantoio, Teccimo, Moroiolo etc.<sup>(4)</sup> The former are found in all Berber gardens while the latter are restricted to the ex-Italian settlements.

Water is helpful in some cases and essential in encouraging the growth of young trees, but after the tree is 3 or 4 years old, it can grow without water in the more humid zones of the Jebel.

At the beginning of winter, the olives are ready for the harvest. A tree can produce an average of approximately 360-400 kilograms, or the equivalent of 60-65 litres of pure oil. On the other hand, the young tree produces about 36-96 kilograms and about 6-15 litres of olive oil.

The number of olive trees in the Jebel Garian is 87,900. Of them 36,800 have been planted by the indigenous people. The

FIG. 35. OLIVE TREES



rest date from Roman and Turkish times. In addition, there are 28,450 Italian olive trees, restricted mainly to the ex-Italian farms in both Beni Daud and Beni Nser (Plate 37). Figure 35 shows the distribution of olive trees in the whole region, and their total number in 1957-58 is as follows:

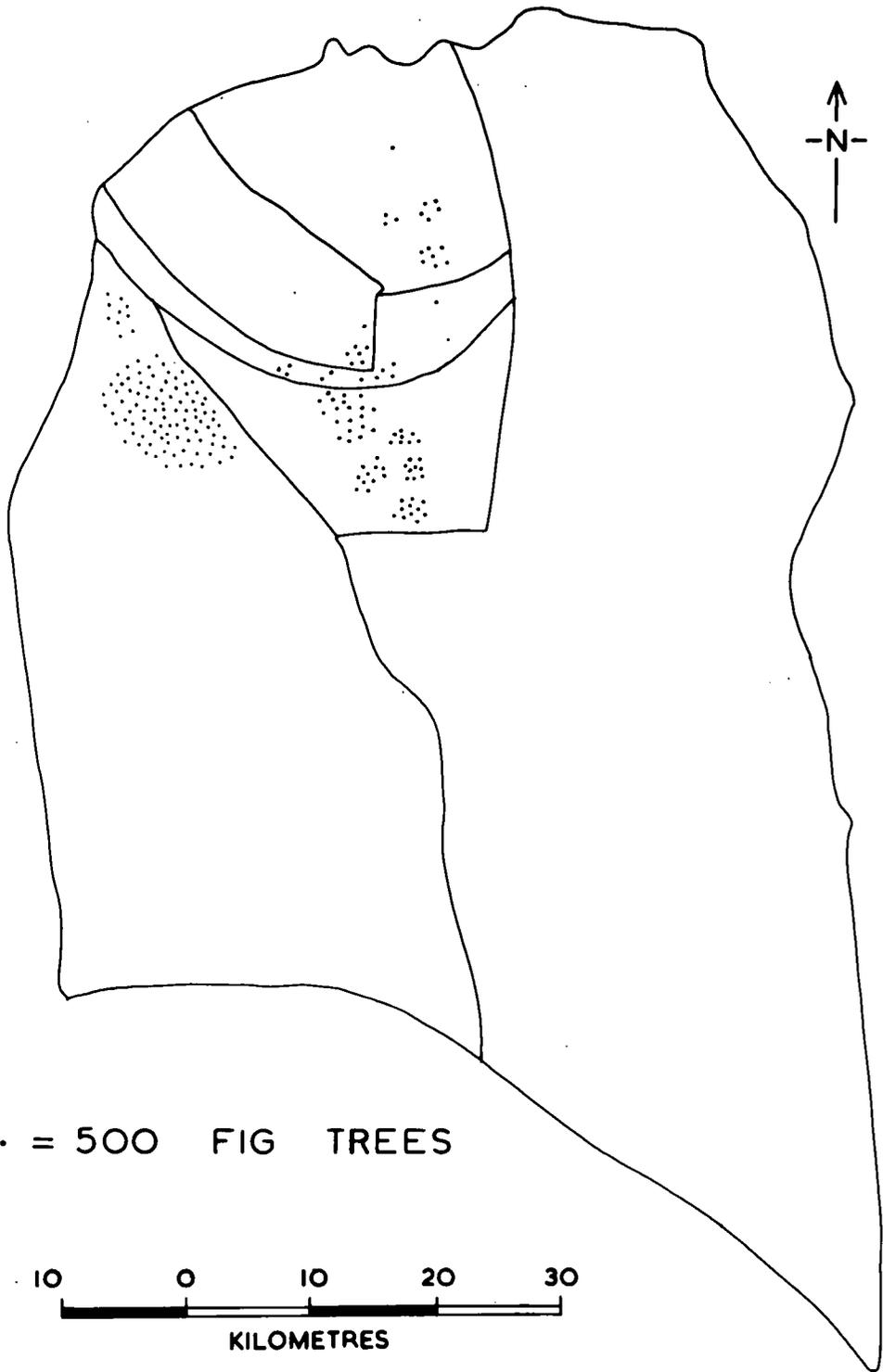
Mudkriyat	Number of trees.	Production in quintals 1957-58	Percentage of Production
Beni Daud	12,500	4,351	27.5%
Beni Nser	11,500	1,620	10.2%
Beni Khalifa	16,500	5,750	36.4%
Al Guasem	16,500	2,400	15.1%
Al Asabaa	1,200	1,700	10.8%
Al Orban	780	-	-
Ex-Italian farms	28,450	-	-
<b>Totals</b>	<b>87,430</b>	<b>15,821</b>	<b>100.0%</b>

This table shows that the olive trees are restricted to the cultivated zones of Berber and ex-Italian dry farming, whilst the semi-nomadic zone of Al Asabaa has few.

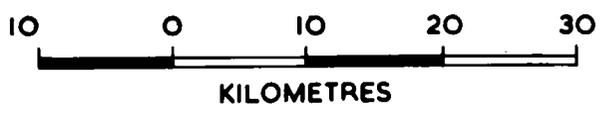
2. Figs in the Jebel Garian assume a position of importance in Berber cultivation similar to that of date palms in the coastal zone of Tripolitania. They grow in all zones of the Jebel (Plate 38 ).

According to the Italian figures of 1926-27<sup>(5)</sup>, the number of fig trees was estimated to be 6,000. They had increased in 1955 to 113,348, but were 109,148 in 1957-58. Figure 36 shows their distribution and the above table illustrates their total number and production.

FIG. 36. FIG TREES



• = 500 FIG TREES



Mudiriyat	No. of trees		Production in quintals 1957-58	Percentage
	Mature	Young		
Beni Daud	3,826	200	17	1.9%
Beni Nser	8,707	1,750	107	11.9%
Beni Khalifa	31,167	2,000	126	14.1%
Al Guasem	7,500	270	375	41.9%
Al Asabaa	52,000	600	165	29.8%
Al Orban	227	200	3	14%
<b>Totals</b>	<b>103,427</b>	<b>5,020</b>	<b>893</b>	<b>100.0%</b>

Although Asabaa has the greatest number of fig trees, its production in 1957-58 was lower than Al Guasem, because the Guasem fig trees are more mature and older than trees in the other zones of the Jebel. Al Asabaa, however, has the second highest rate of fig production. Although Beni Khalifa has a large number of trees, its production is lower than that of Al Guasem. This may be explained by the diseases which have affected the fertility of the fig trees in this zone of the Jebel.

Methods of cultivation appear to be similar over the whole region. In other words, both Berbers and Arabs plant young figs on minor terraces or in small gardens. The cultivators tend the young trees for a few years until they begin to bear fruit. The local figs, generally, can resist the dry conditions and benefit only from absorption of the humidity which exists in the sandy formations. <sup>(6)</sup> They are white in colour and are different from the figs of the coastal zone of Tripolitania. Figs are sold in Garian market or are kept for domestic consumption, whereas very small quantities are exported to the coastal

towns.

3. Dates are another important crop in the Jebel, but they are cultivated only in Rabta al Garbia and Rabta al Shargia at the foot of the escarpment, Wadi Torshin<sup>(\*)</sup> (Plate 39), Slahat (Plate 40), and Wadi el Hammam. Figure 37 shows their distribution in the region.

The date palms normally grow either in the bottom of the wadis or near the springs, where in general the water-table is near the surface. Certain types, however, grow naturally in Bu Gheilan whereas others in Rabta al Garbia and Rabta al Shargia etc., are cultivated. The number of date palms is 9,239 and are distributed as follows:

Mudiriyat	Number of Trees	Production in quintals 1957-58	Percentage of Production
Beni Daud	140	16	1.6%
Beni Nser	1,139	184	18.8%
Beni Khalifa	82	39	4.1%
Al Guasem	670	56	5.7%
Al Asabaa	7,053	648	66.3%
Al Orban	155	34	3.5%
<b>Totals</b>	<b>9,239</b>	<b>977</b>	<b>100.0%</b>

The largest number of trees is found in Al Asabaa and this area produces more dates than any other zone in the region. This is due to the fact that dates are more densely cultivated in the Rabtās. Beni Nser is regarded as the second zone, since a

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\* A tributary of Wadi el Arbaa.

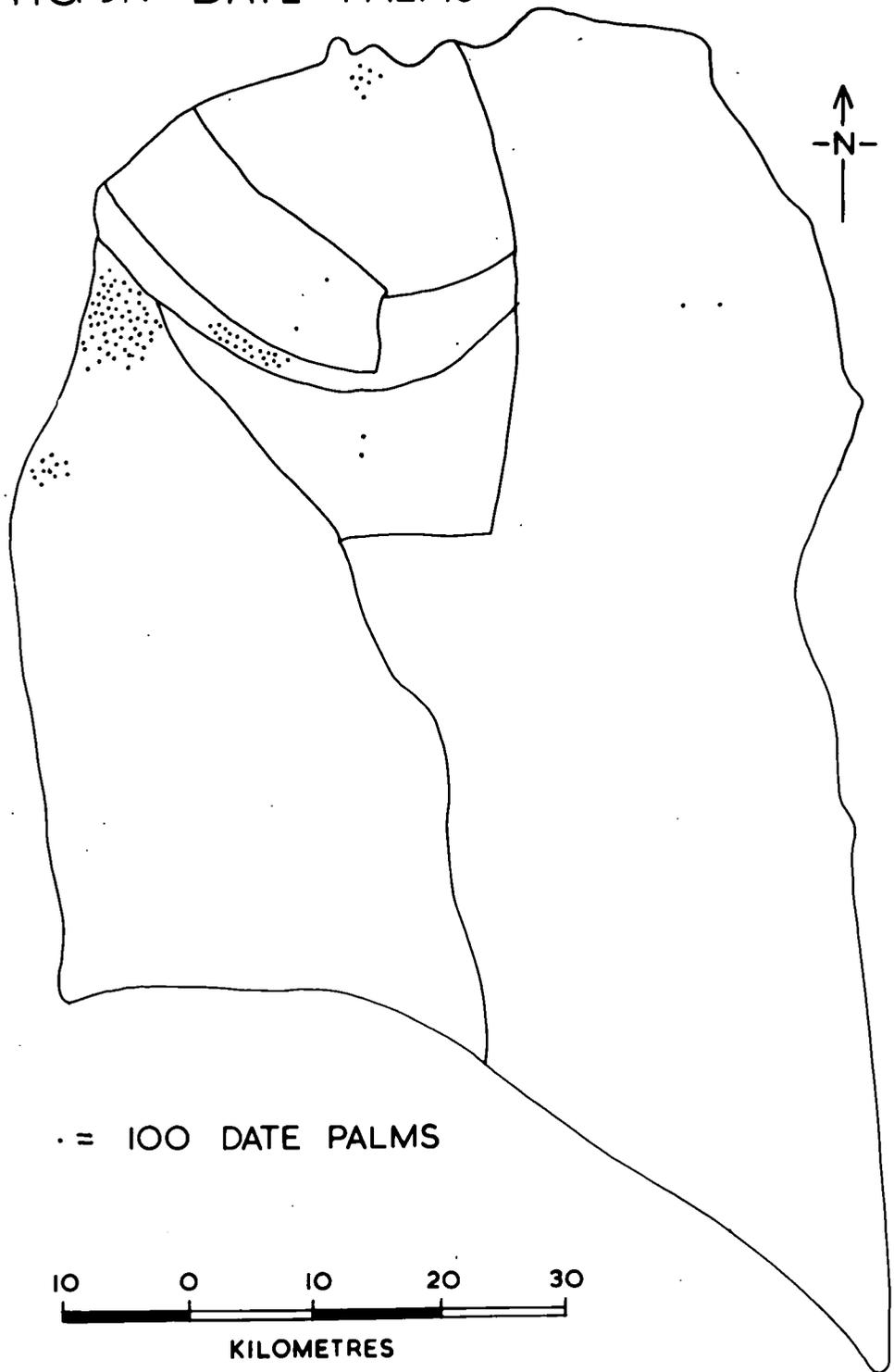
considerable number of trees grow in Slahat at the bed of Wadi Gan and Bu Ayyad at the bottom of Wadi Tirshin.

The quality of the Jebel date palms is to some extent inferior to that of Tunisian dates, probably due to less favourable climatic conditions.<sup>(7)</sup> The dates are preserved by removing the stems, sun-drying and pressing into blocks, and an alcoholic drink called 'Bukha' may be obtained by fermentation. Another less intoxicating drink called 'laghbi' may be extracted from the trunk of the palm. From the leaves fibre is obtained to make rope and baskets, and the trunk may be used for timber and fuel. It is often used for the headgear of the wells. Yields per tree are not high, the average yield per tree being 20 kilogrammes.

The Arabised Bebers of both Rabtās sell a third of their crop, the remainder being retained for domestic purposes. Dates are mostly eaten during the cooler weather and a large barter trade exists between the oases and the sedentary people of the Jebel. The semi-nomads of Al Asabaa, in particular, who, having insufficient vegetables, eat more dates than the oasis dwellers.

Date palms are normally propagated from the suckers of female trees. There is no insect pest or disease which attacks the local palms and the only labour and expense in the industry is that involved by watering young palms for a season. The date palms do not require artificial fertilizing, and they resist poor soil conditions. Moreover, they can flourish in marshy

FIG. 37. DATE PALMS



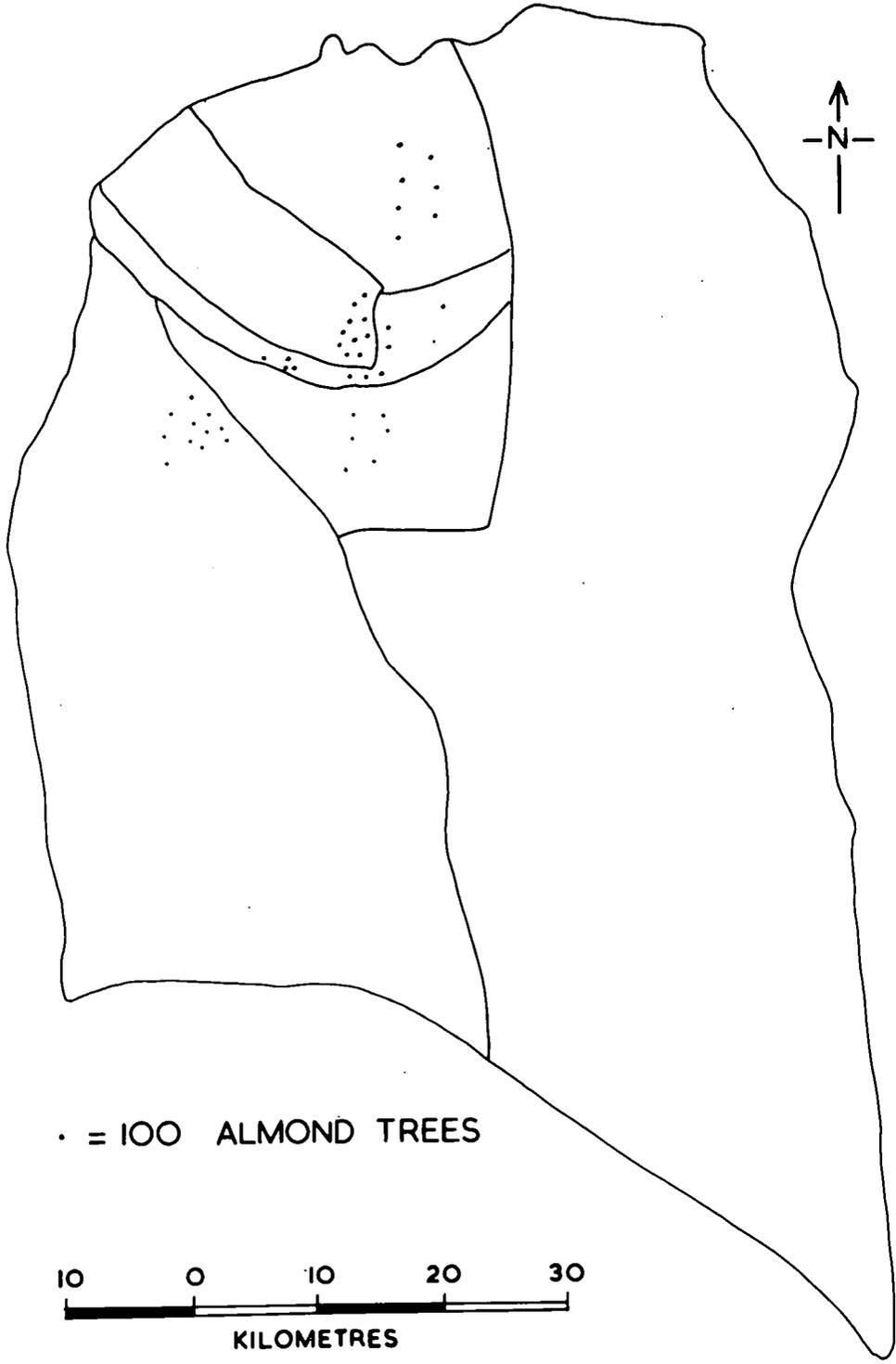
areas as for instance both Rabtās, and can endure a greater degree of salinity than any other cultivated crop in this section of the Jebel. In other words, the quality of the soil and the water need not be high.

4. Almonds are found over the whole cultivated zone in both Berber and Arab dry gardens, and are often associated with olive, fig and other fruit trees (Fig. 38 ). Their distribution is as follows:

Mudiriyat	Number of trees	Production in quintals 1957-58	Percentage of Production
Beni Daud	1,465	98	21.9%
Beni Nser	970	80	17.8%
Beni Khalifa	570	110	24.6%
Al Guasem	730	40	8.9%
Al Asabaa	2,120	120	26.8%
Al Orban	100	None	-
<b>Totals</b>	<b>5,955</b>	<b>448</b>	<b>100.0%</b>

Al Asabaa is again the most important zone for both the number of trees and their production capacity, though the semi-nomads of this region have only recently commenced development of their lands. The success of almonds is due partly to the extensive areas which exist in this part of the Jebel, and partly to the fertility of the cultivated zone which has been brought into utilization since the second world war. Although Beni Daud comes next in number, its production was low in 1957-58 compared with Beni Khalifa which produced 24.6 per cent of the whole crop. The low production in the other Mudiriyats may be

FIG.38. ALMOND TREES



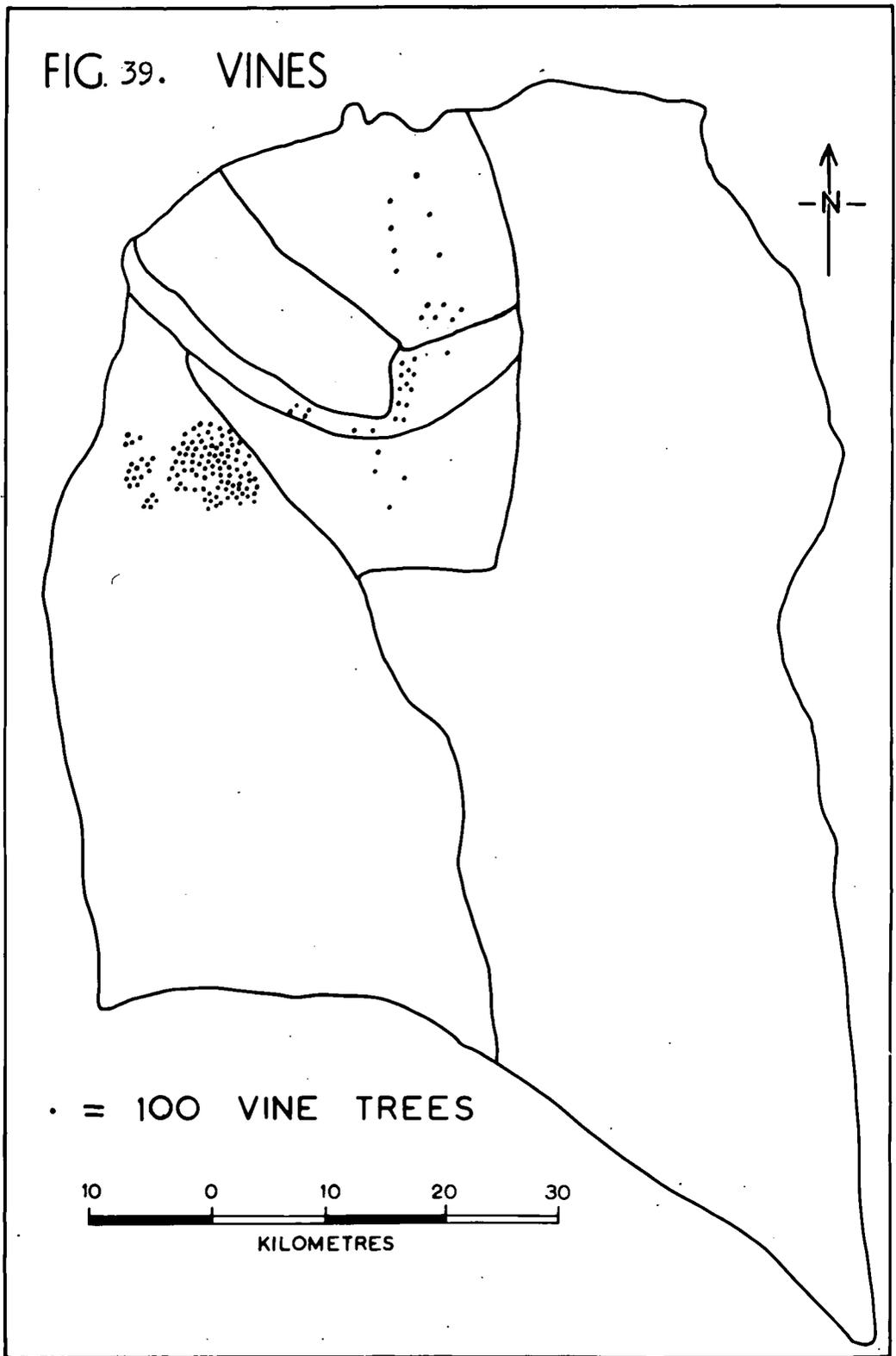
accounted for by the fact that a great number of the trees are still too young to bear fruit.

Generally speaking, the Jebel almonds are well adapted to natural conditions but are still very sensitive to violent winds and sharp falls of temperature at flowering time. They grow in the Jebel without irrigation and can rely only on rainfall during the wet months of the year. They generally begin to bear significant quantities of nuts after five or six years.

Sinclair<sup>(8)</sup> stated that the sweet eating almond can be sold either in the green stage or as the dried nut and there is also a sale for the unbudded or bitter almond on account of its oil. However, the Jebel farmers sell most of their own produce, either through the Garian market or Tripoli, and reserve very small quantities for their own consumption.

5. Grapes are grown in the whole cultivated zone of the Jebel, but are to a large extent concentrated in Al Asabaa and Beni Daud. Grapes are normally found in the small Berber and Arab gardens, together with olives and other soft fruits. The number of vines is 18,635 (Fig. 39 ). Their distribution and production in 1957-58 among the administrative units of the region is as follows:

FIG. 39. VINES



Mudiriyat	Number of trees	Production in quintals 1957-58	Percentage of Production
Beni Daud	3,900	100	36.8%
Beni Nser	1,895	50	18.4%
Beni Khalifa	360	52	19.1%
Al Guasem	1,360	20	7.3%
Al Asabaa	11,320	50	18.4%
Al Orban	None	-	-
<b>Totals</b>	<b>18,635</b>	<b>272</b>	<b>100.0%</b>

It appears from the table that in spite of the large number of vines in Al Asabaa, the production of grapes was low compared with Beni Daud which produced 36.8 per cent of the total amount. This may be because the vines in Al Asabaa are still young and so far do not give a heavy production. The table indicates also that Guasem has few trees and their production is low. At Al Orban, the semi-nomads of this zone do not tend to plant vines because they favour shifting cultivation and grazing livestock.

The Jebel soil is to some extent suitable for the cultivation of vines, since it is not poor in lime and the sandy subsoil is able to retain water. Grapes, in particular, are more susceptible than olives or almonds to drought, hot Ghibli winds and blowing sand. The Italian farmers in the Tigrinna Estate introduced to the Jebel in 1933 new varieties which are more suitable for producing vines, whilst the existing varieties in both Berber and Arab gardens are for eating, as the indigenous cultivators have little desire or interest in making wine owing to their religious principles.

The grapes are planted in rows and pruned very short as is the custom in Sicily and Tunisia.<sup>(9)</sup> The budwood variety was originally introduced from Italy or Tunisia, but local stocks are plentiful and of good quality for eating. The average yield per vine is equal to 9 kgs. of grapes for wine or 1 kg. grapes for table.<sup>(10)</sup>

6. Peaches (Fig. 40 ) are widely planted in the Jebel and often grafted on to almonds. They can bear fruit after 3-4 years. They are small and not very sweet, but flourish in this region. There are two varieties called Nattachi and Falugha. Their distribution in 1957-58 is as follows:

Mudiriyat	Number of Trees		Production in Quintals 1957-58	Percentage of Production
	Mature	Young		
Beni Daud	975	180	21	4.3%
Beni Nser	8,140	6,800	282	57.9%
Beni Khalifa	1,150	1,500	15	3.9%
Al Guasem	2,700	300	135	25.7%
Al Asabaa	6,000	1,000	35	8.2%
Al Orban	None	None	-	-
<b>Totals</b>	<b>18,965</b>	<b>9,780</b>	<b>488</b>	<b>100.0%</b>

7. Apricots (Fig. 41) are similar to peaches in that they are widely grown in dry gardens and are always grown from seed. The tree can bear fruit after 8 years, and 45-60 kgs. can be produced by a mature tree. There are three main types: Meeshmash lusi, Aidia and Hammuri.

Their distribution and production for 1957-58 is as follows:

FIG.40. PEACH TREES

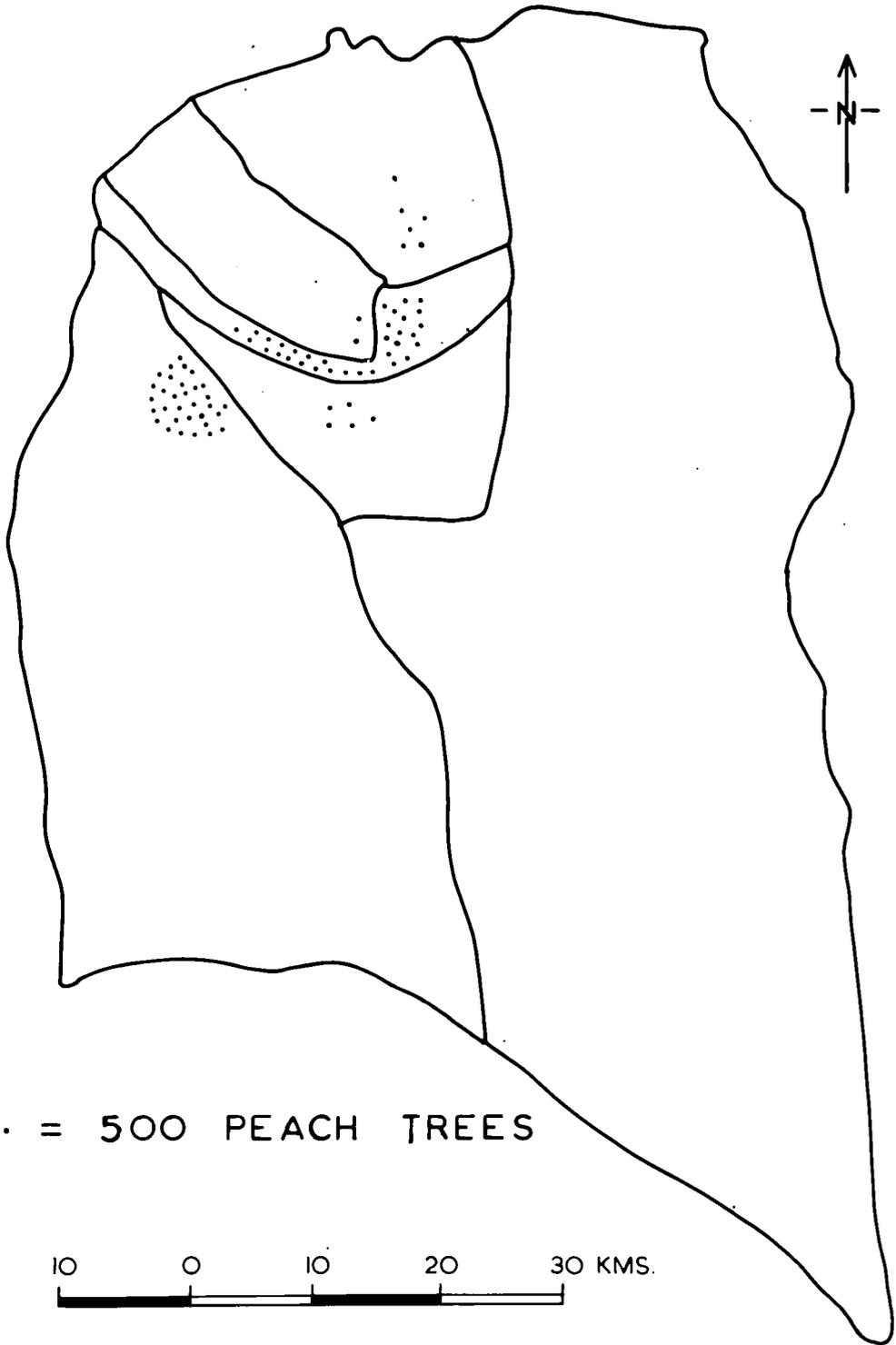
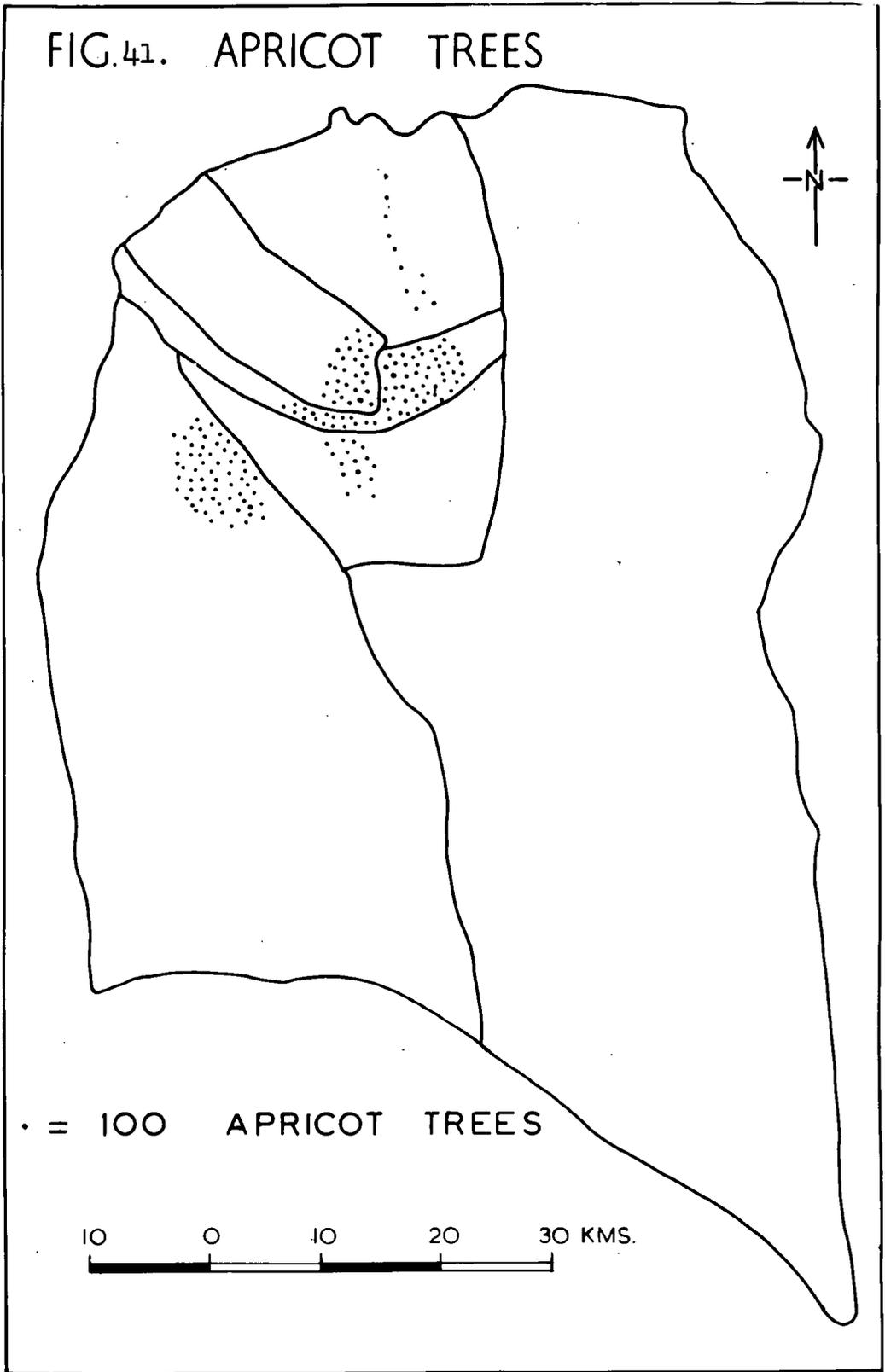


FIG.41. APRICOT TREES



Mudiriyat	Number of trees		Production in quintals 1957-58	Percentage of Production
	Matured	Young		
Beni Daud	110	180	5	10.0%
Beni Nser	300	350	28	56.0%
Beni Khalifa	90	70	11	22.0%
Al Guasem	80	30	3	6.0%
Al Asabaa	100	500	3	6.0%
Al Orban	None	None	-	-
<b>Totals</b>	<b>680</b>	<b>1,130</b>	<b>50</b>	<b>100.0%</b>

8. Plums (Fig. 42) are grown mainly in irrigated gardens in Kmashat, Rabtās and Bu Ayyad and are also grown in dry gardens. They are sown in holes 40-50 cm. deep, and usually bear fruit after 3½ years. They flower in April and are harvested in autumn. Plums are found only in restricted areas of the Jebel. The estimated number of trees and their production is shown in the following table:

Mudiriyat	Number of trees		Production in quintals 1957-58	Percentage of Production
	Mature	Young		
Beni Daud	60	40	3	0.2%
Beni Nser	200	240	24	72.6%
Beni Khalifa	-	-	-	-
Al Guasem	-	-	-	-
Al Asabaa	130	800	10	27.2%
Al Orban	-	-	-	-
<b>Totals</b>	<b>390</b>	<b>1,080</b>	<b>37</b>	<b>100.0%</b>

Apples and pomegranates are grown in the Jebel in most of the Berber and ex-Italian farms (Figs. 43, 44). Their distribution

FIG. 42. PLUM TREES

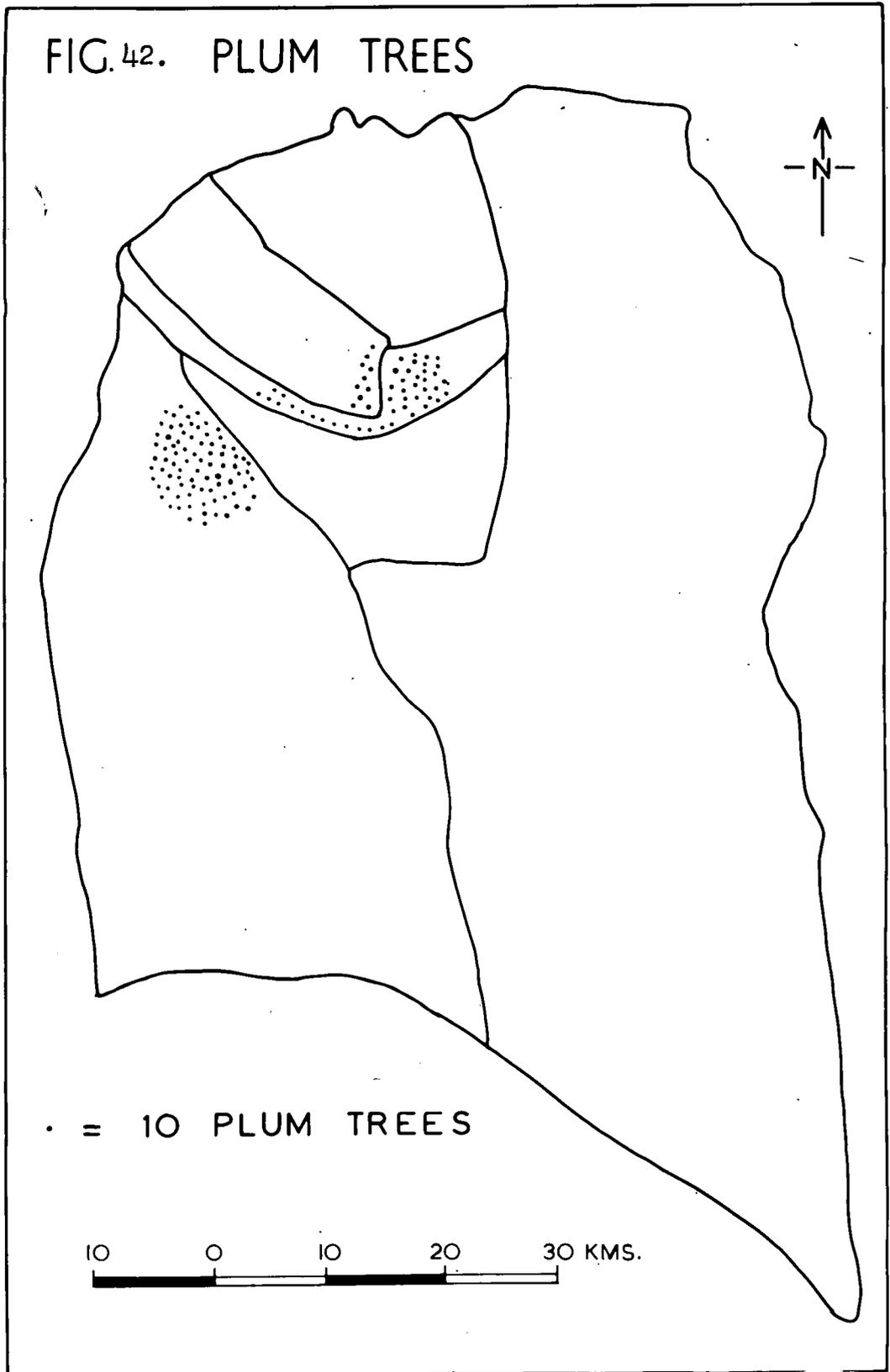


FIG. 43. APPLE TREES

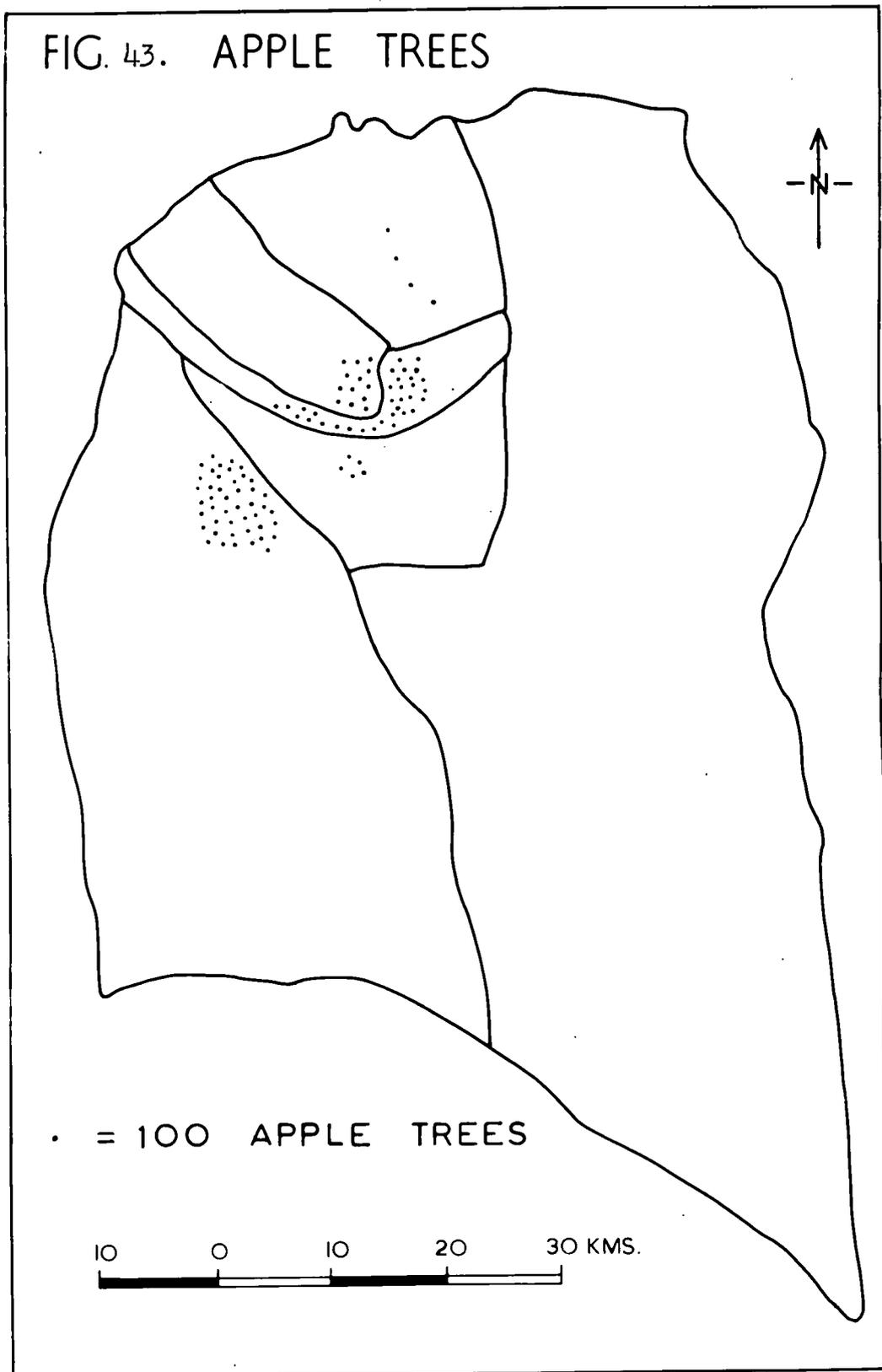
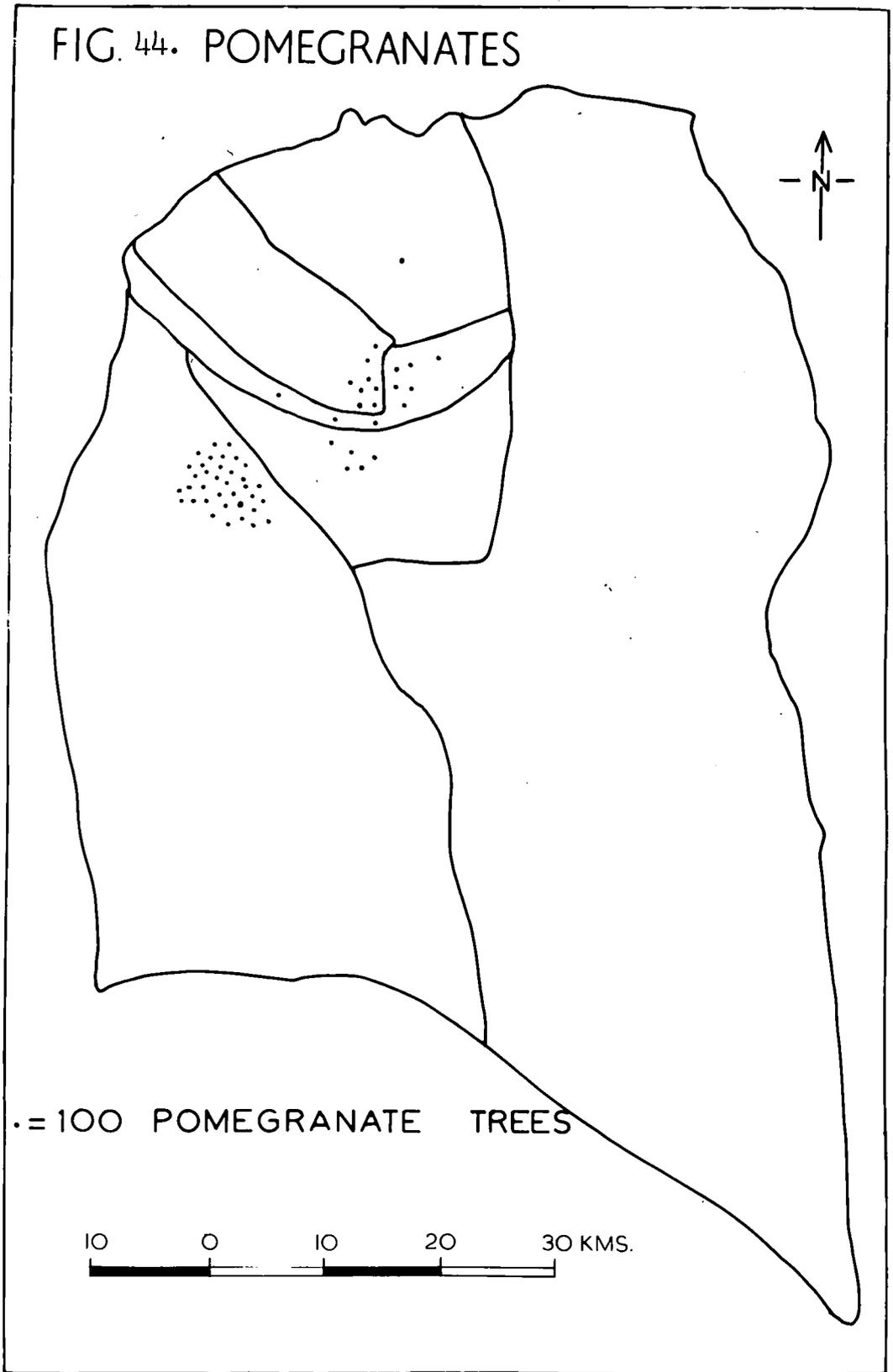


FIG. 44. POMEGRANATES



and production in 1957-58 is as follows:

Apples

Mudiriyyat	Number of trees Mature	Young	Production in quintals 1957-58	Percentage of Production
Beni Daud	150	220	3	1.7%
Beni Nser	2,200	1,300	28	13.4%
Beni Khalifa	400	150	130	64.1%
Al Guasem	170	240	17	8.4%
Al Asabaa	500	4,000	25	12.4%
Al Orban	None	-	-	-
Totals	3,420	5,910	203	100.0%

Pomegranates

Mudiriyyat	Number of trees Mature	Young	Production in quintals 1957-58	Percentage of Production
Beni Daud	50	30	2	11.2%
Beni Nser	60	30	4	22.2%
Beni Khalifa	-	55	-	-
Al Guasem	15	-	1	
Al Asabaa	110	250	11	
Al Orban	-	-	-	
Totals	235	360	18	100.0%

Generally speaking, the possibility of increasing the number of fruit trees is great in both Al Asabaa and Al Orban which contain extensive areas of fallow land in the more humid zone. Some efforts could be made to encourage the semi-nomads to grow fruit trees which would be able to survive the arid conditions of the region, especially olives which are the most important trees.

## VEGETABLES

The growing of vegetables is limited in the Jebel to specific areas where perennial water resources are available as for instance Rabta al Garbia and Rabta al Shargia, Kmashat and Slahat. In these zones, the gardeners use irrigation for growing many kinds of summer vegetables such as peas, beans, tomatoes, green peppers, broad beans, onions and potatoes. Winter vegetables are cabbage, cauliflowers, carrots, turnips, spinach and lettuce.

Both winter and summer vegetables can be grown in all the dry Berber and ex-Italian farms for family consumption. Vegetables can be irrigated by means of the water of the cisterns or reservoirs in order to support their home requirements. In Rabta al Garbia and Rabta al Shargia, the gardeners grow vegetables for commercial consumption. They export considerable quantities of vegetables daily to the market and shops of Garian.

The quality of vegetables in general is good with the exception of those of Rabta al Garbia where salinity affects the cultivation of some kinds of vegetables as for instance green pepper and tomatoes.

It is difficult for the gardeners of both Rabtias to transport their vegetables to Garian as there are no regular means of communication with the town. Therefore they use animals for transporting the vegetables over the 32 kilometres. Kmashat and Slahat gardeners are facing the same problem and they also use donkeys for transporting their agricultural products to market (about 10 kilometres).

COMMERCIAL CROPS

TOBACCO

X Tobacco is the only commercial crop and the most important agricultural product of the Jebel Garian within Libya as a whole. In Libya, tobacco cultivation is strictly controlled by the State Monopoly which not only maintains the standard of culture but also restricts the area under cultivation each year. Garian is the principal zone for the production of tobacco within Tripolitania, contributing much to the produce of the province. From the farmers' viewpoint, it is highly esteemed since there is a guaranteed market and a guaranteed price.

The only variety grown in the Jebel is the Perustitza or Oriental type which originated from Bulgaria but is now raised from Italian seed. (11) This seed is imported annually from Italy and is cultivated only in the Jebel areas. It is a non-irrigated crop relying entirely on seasonal rainfall for its development.

The cultivation of tobacco was introduced by the Italians in 1928 who formed the precursor of the present State Monopoly then under the administration of the A.T.I. after 1933. (12) At the present, tobacco cultivation is restricted to the ex-Italian farms at Tigrinna Estate, and to some farmers (mainly Berber) in Al Guasem and Beni Khalifa.

In this zone, the environmental features are well suited to the production of tobacco. The land is either flat or gently

sloping with few rock outcrops or deep gullying. The whole area is covered by a deep loose and sandy soil which enables full development of the tobacco plant. Moreover, this zone has a higher rainfall than other parts of the Jebel. Figure 45 shows that annual production fluctuates from one year to another. This is due to the unreliability of the rainfall, a characteristic of the whole Libyan climate. Thus, the drought years of 1936, 1947 and 1954 gave the lowest yields except for the war years. The influence of rainfall on production is shown further in the years between 1943 and 1950 by comparing production with area under cultivation (Fig. 46). The area under cultivation has tended to increase with the exception of 1945, 1949 and 1958. The area under cultivation is fixed by the State Tobacco Monopoly and varies according to market assessment. Decline in the area under tobacco cultivation is due on the whole to the general policy of the State Monopoly which has the full right to reduce, in any year, the area of cultivated land, because the market for tobacco is limited to the small and poor population of Libya.

#### Method of tobacco cultivation

Tobacco is a crop with several prerequisites to cultivation. Firstly, it must be restricted to a specific area on the farm which must also be ploughed deeply by a tractor. Then it must be left for three months in order to absorb adequate moisture. The land that is to be cultivated must be carefully cleaned from weeds harmful to the growth of tobacco. Furthermore, livestock

FIG. 45. PRODUCTION OF TOBACCO  
(IN QUINTALS 1928-1957)

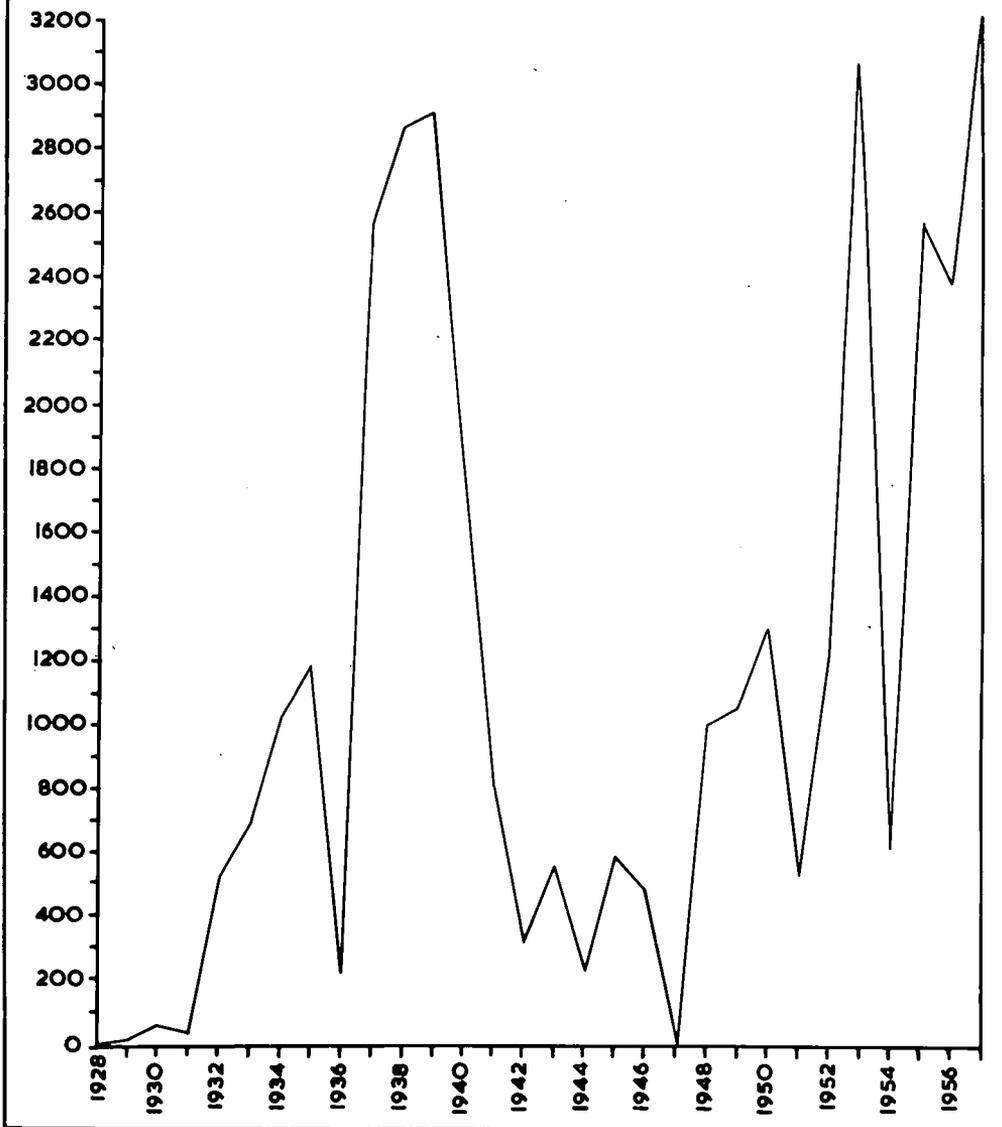
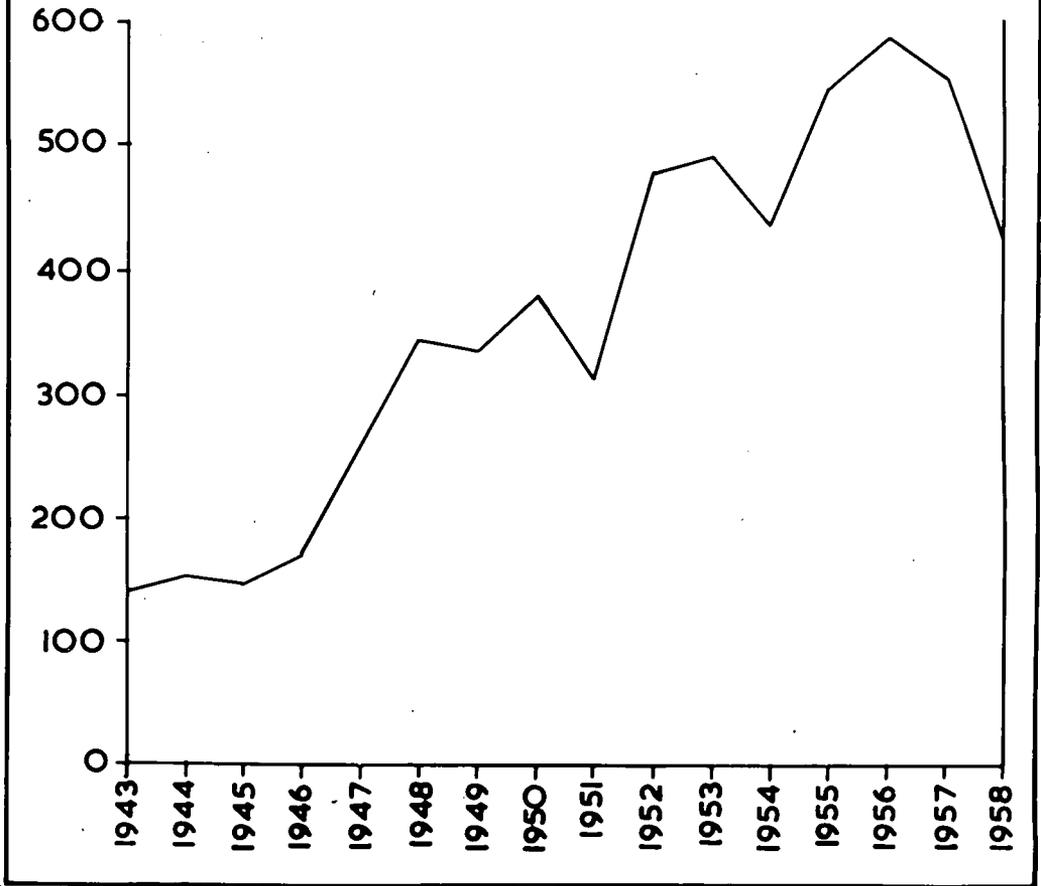


FIG. 46. HECTARAGE OF TOBACCO  
AVAILABLE DATA SINCE 1943 ONLY



must be prevented from trampling over the ploughed soil and impairing the benefits of both sunshine and rainfall.<sup>(13)</sup>

At the beginning of October, the State Tobacco Monopoly in Garian distributes seeds to the farmers (mainly to the Berber farmers who have settled since 1958 on the ex-Italian farms). Then the farmer is required to produce two or three boxes in which a quantity of good soil is placed. The soil must first be cleaned of grass and pebbles and then inorganic fertilizer must be added to the prepared soil. After this operation, the farmer sows the seeds carefully and covers the box with a cotton sheet. He has to irrigate the tobacco seeds daily until they have reached the surface of the soil. This operation takes about one month. As soon as the tobacco plant appears, the farmer must look after it until the end of March, when weather conditions improve and temperatures gradually rise. Then the farmer must transport the growing shoots from the boxes to the field. Every plant must be transported carefully and independently.

Harvesting commences at the beginning of June, and lasts usually until the beginning of October, because the farmer must harvest each plant as it ripens and not wait until all are ready for harvesting.

The tobacco leaf is generally small, feather butted, aromatic and delicate, requiring careful manipulation at all stages, and a comparatively long period of fermentation under an even temperature. It is sorted into two factory grades classified as American Grades,

and Grades IV or Kappa. (14) Then it undergoes a secondary fermentation in open-sided bales of 25-30 kgs. nett.

### Crop Yields

The average yield per hectare is 400 kgs. dry leaf, at 14% moisture content. Maximum yields may go as high as 1,000 kgs. dry leaf per hectare in exceptional circumstances. Yields depend entirely on the amount of rainfall which occurs during the planting and early growing periods. However, in general the higher the yield the poorer the quality.

Perustitza can be described as an average quality oriental tobacco, when manipulated and fermented properly. But it has a distinct pungency, which makes its use in cigarettes very limited. At present there is a tendency for Jebel farmers to plant hybrid Perustitza from self-controlled seed, which gives higher yields but is of inferior quality.

Finally, the possibilities of extending the cultivation of tobacco in the future seem to be quite good since soil and climatic conditions suitable to tobacco are found in large areas of the Jebel. In both Al Asabaa and Beni Khalifa, there are extensive fallow lands which may be developed for this crop. The ex-Italian Government was going to appropriate the utilised zones in both Mudiriyats in order to enlarge the area of land under tobacco cultivation and to support more Italian settlers; but the Italian schemes were prevented by the outbreak of war.

At present the Tripolitanian Government has no serious desire

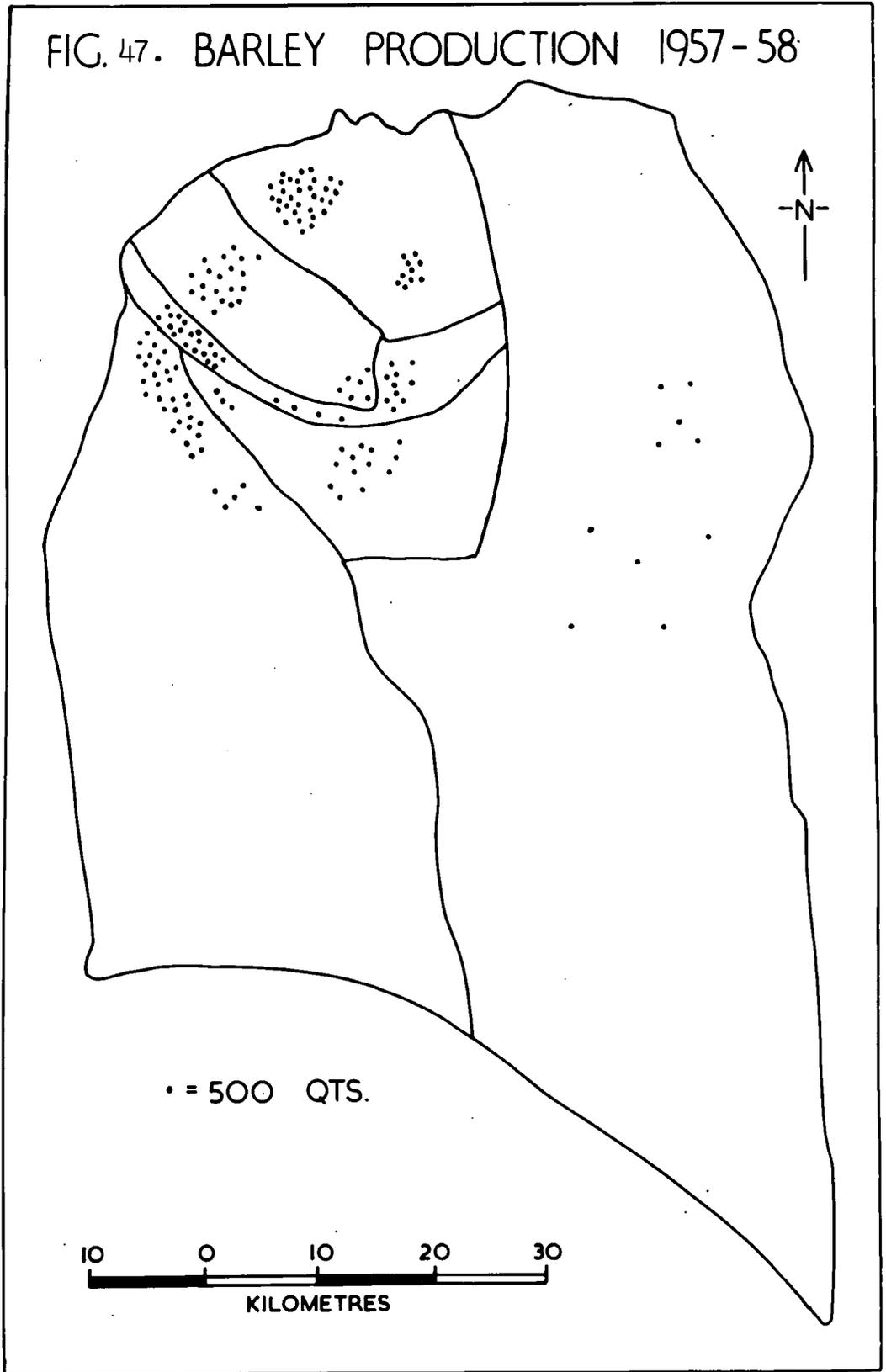
to enlarge the cultivable lands for tobacco cultivation for a variety of reasons. In the first place, the present high scale of annual production of tobacco does not encourage the State Monopoly to go further in its agricultural policy for this crop. Secondly, according to official sources in the Tripolitanian Government, there is no good market abroad, since the U.S.A., Germany, Greece, Cuba, Italy, Turkey, etc., all produce varieties of higher quality than the prototype in Libya. However, if the Government is determined to impose high taxes on foreign cigarettes, this may encourage both State Tobacco and the farmers to cultivate more tobacco not only for home consumption but also for export to U.A.R. and other countries in the Middle East. This is the only likely solution to the development of the agricultural economy in the Jebel Garian.

#### CEREALS

The production of cereals is the largest source of income to the inhabitants of the Jebel. On the ex-Italian settlements, it forms an important contribution to domestic needs.

- (a) Barley is in fact the most basic food crop in the region and the greatest proportion of people prefer the cultivation of barley to wheat. It forms 67.8 per cent of the total production of crops by weight. Barley is cultivated extensively in the Gattis and the Ghibla lands and also by the Berbers and Arabs in their own cabila. This is the case in Al Guasem, Beni Khalifa and in the western section of both Beni Dand and Beni Nser. Cultivation

FIG. 47. BARLEY PRODUCTION 1957-58



of barley to the east of the two Mudiriyats is limited, owing to restrictions imposed by the Italian settlements in Tigrinna. In both Al Orban and Al Asabaa, the semi-nomads practise shifting cultivation of barley on a large scale.

The total production of barley in 1957-58 was 78,458 quintals in an area which equals 16,672 hectares. The distribution of barley is illustrated by figure 47 and the following table.

<u>Mudiriyat</u>	<u>Production in quintals (1957-58)</u>	<u>Percentage of Production</u>
Beni Dand	12,898	16.5%
Beni Nser	16,146	20.6%
Beni Khalifa	5,480	6.9%
Al Guasem	21,216	26.9%
Al Asabaa	17,758	22.4%
Al Orban	<u>4,960</u>	<u>6.7%</u>
<u>Totals</u>	<u>78,458</u>	<u>100.0%</u>

This table shows that Al Guasem was the most important area for the production of barley. This may be due to the position of Al Guasem with its higher rainfall, good soils and gentle slopes though the area is smaller than Al Asabaa which has the second highest production. Although Al Orban is extensive, it has the lowest production of barley because of its accidental surfaces.

However, the Jebel people grow barley for home consumption only. The cultivators commence ploughing at the beginning of autumn when the soil receives rainfall, but this operation is

delayed in the Gattis lands until the quantities of rainfall are sufficient for the beginning of cultivation. Harvesting of barley starts at the beginning of May until the 15th May.

- (b) Wheat (fig.48) is less important than barley, though it is grown in certain areas as a winter crop, particularly when there is the prospect of good prices. Wheat grows successfully over the Jebel and Gattis land. The total area of wheat in 1957-58 was 5,942 hectares. Wheat production in the Jebel Mudiriyats is recorded as 17,893 quintals.

Wheat Production, Garian, 1957-58.

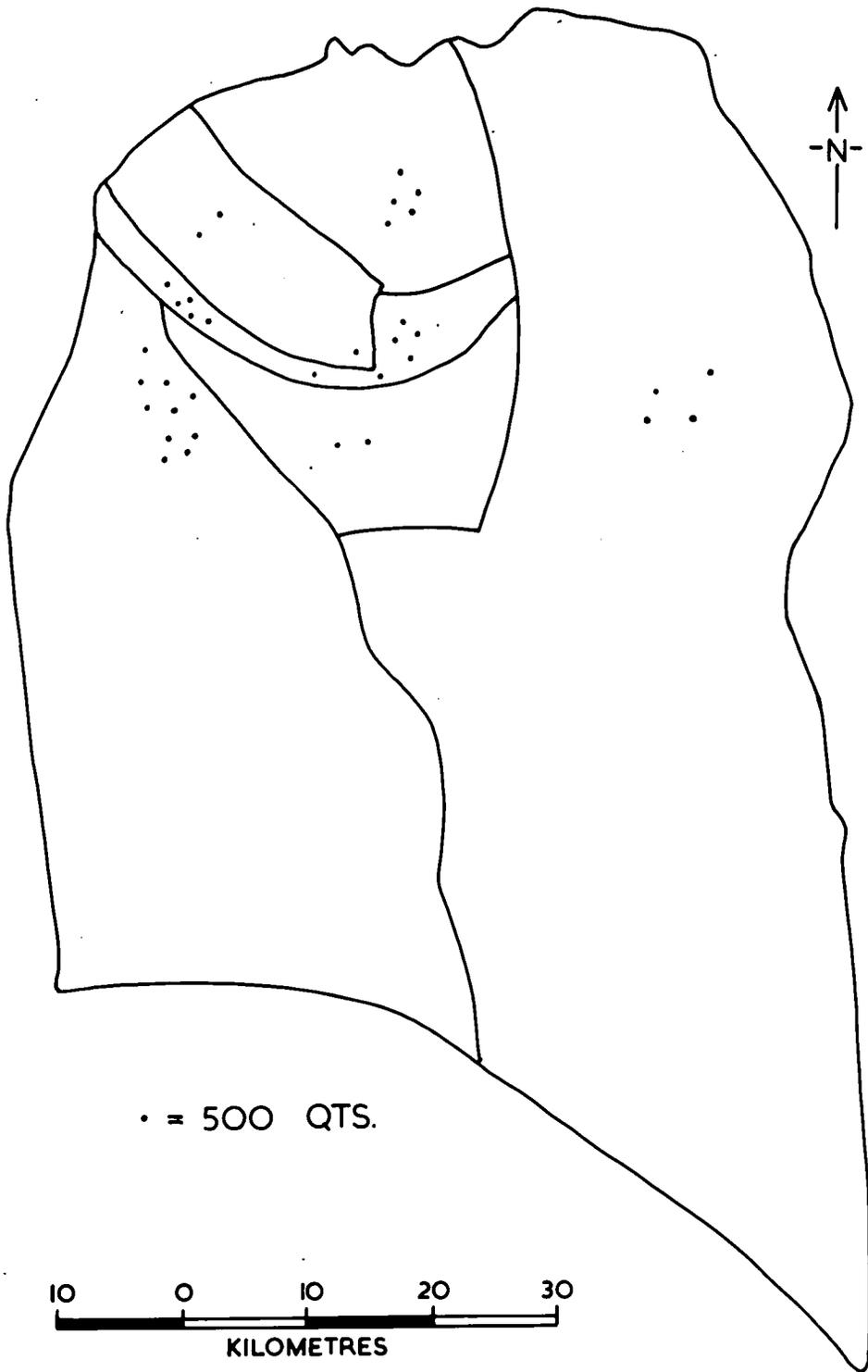
<u>Mudiriyat.</u>	<u>Production in Quintals</u>	<u>Percentage of Production</u>
Beni Dand	1,394	7.9%
Beni Nser	5,626	31.5%
B eni Khalifa	800	4.6%
Al Guasem	2,488	13.4%
Al Asabaa	5,233	29.3%
Al Orban	<u>2,352</u>	<u>13.3%</u>
<u>Totals</u>	<u>17,893</u>	<u>100.0%</u>

This table shows that the highest production of wheat is found in Beni Daud, Beni Nser and Al Asabaa. The cultivators of Beni Nser and Beni Khalifa cultivate wheat only in the Jebel and Gattis but have no right to sow cereals in the Ghibla land. (1)

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(1) The Tripolitanian Government prohibited the tribes of Beni Nser, Beni Khalifa and Al Orban from sowing cereals or practising pastoralism after the clashes in 1955 between the Berbers and the Arabs over the Ghibla.

FIG. 48. WHEAT PRODUCTION 1957-58



In the case of Al Asabaa, fallow land is found over extensive areas which could produce high yields of cereals.

### ESPARTO.

Esparto or halfa grass is an important uncultivated crop since it is in high demand for the manufacture of high quality paper and banknotes.<sup>(1)</sup> This type of cash crop is to be found growing naturally in the whole of the Jebel Garian with the exception of the cultivated lands in Beni Daud, Beni Nser, Beni Khalifa and Al Guasem. Esparto in fact grows well throughout the Mudiriyat Al Orban (Plate 41 ), and the central and southern zones of Al Asabaa. About three quarters of the total production comes from Al Orban. Moreover, esparto grows sparsely to the eastern section of Wadi Gan and the southern zone of Beni Khalifa.

This plant at one time covered the whole region, but now it is declining; maybe after 50 years it may find difficulty in surviving. However, this crop is a very important source of cash income, particularly during the years of drought when income from other sources is low. The grass is collected and exported through a monopoly (the Esparto Company). The local population harvest the esparto by hand pulling, beginning at the end of August and carrying on until the beginning of April. The grass

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(1) There are actually two different genera of the so-called esparto grass with different characteristics and uses: Spartum Ligeum which is used primarily for making household articles, and Stipa tenacissima which is used for quality paper making. (15)

in this period can flourish as a result of the greater rainfall and soil moisture.

The production of esparto in the Jebel varies from one year to another, since two or more years' growth may have accumulated before pulling. The value of exports was about £260,000 in 1948, (a year of drought) but fell to £165,000 the following year when the drought was broken.<sup>(1)</sup> There is evidence that the high production in 1948 was, in part, due to the heavier growth which had accumulated during the war years when little pulling occurred. The production of esparto between 1952 and 1957 was fairly stable as indicated by the following figures:

<u>Year</u>	<u>Production in quintals</u>
1952	17,928
1953	17,395
1954	16,158
1955	19,180
1956	16,964
1957	15,058
	<hr/>
Totals	<u>104,484</u>

It may be noted from this figure that the highest production occurred in 1955, whilst the production in the other years was

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(1) Under Turkish rule from 1881 to 1890, 40,000 tons were reported collected per annum; from 1900 to 1910, 10-20,000 tons; but during the Italian occupation from 1911 a maximum of only 80,000 tons of esparto was gathered, reputedly due to the numerous employment opportunities in the Military and other Government projects.

similar.

LIVESTOCK.

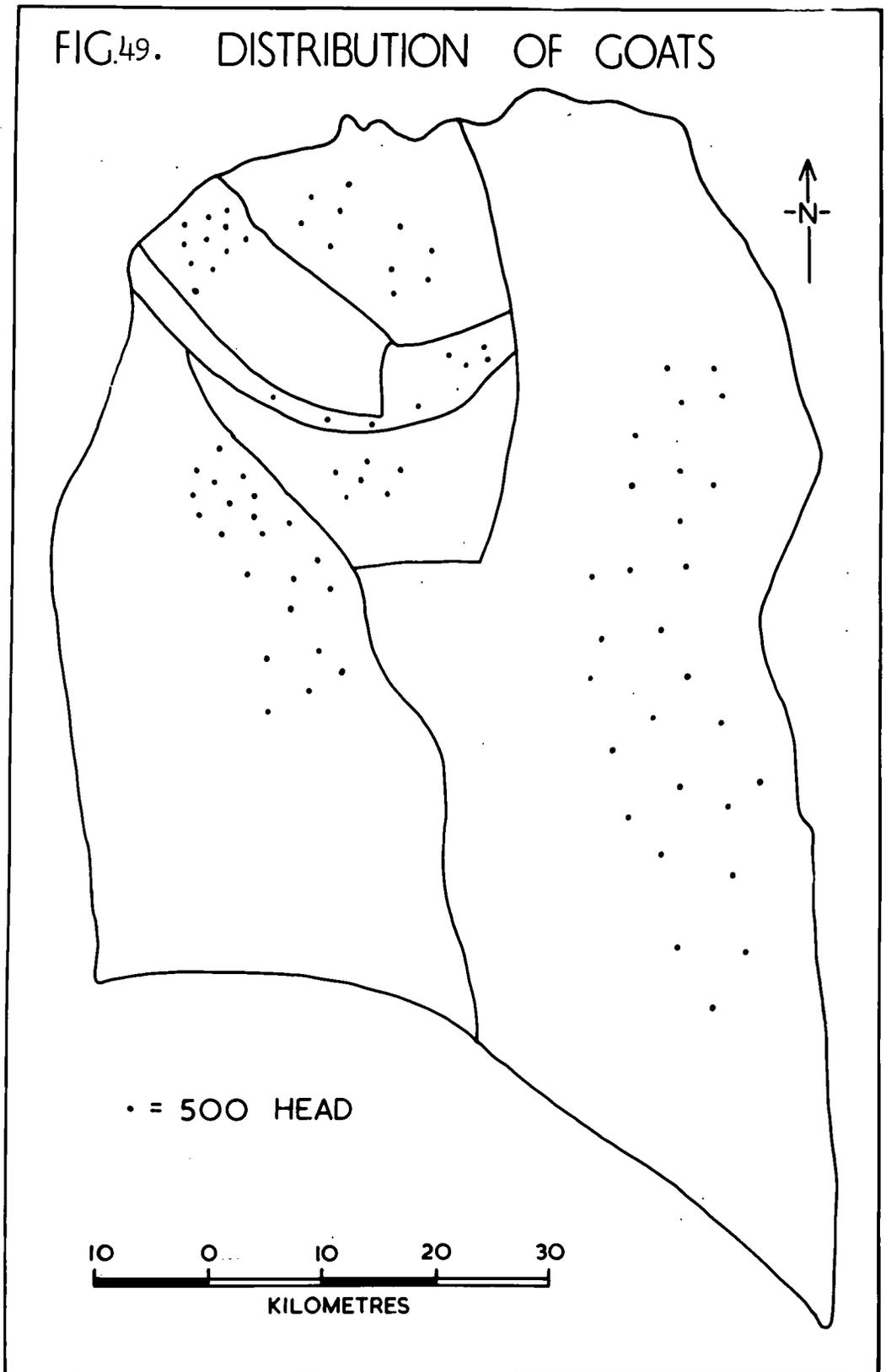
The livestock industry is a most important source of income in the Jebel Garian and is considered the main agricultural activity of the inhabitants. Animal husbandry is carried out by both Berbers and Arabs. Most of the settled and semi-nomadic tribes own sheep, goats, camels and donkeys. The sedentary tribes in fact do not themselves practise pastoralism, but they deliver their animals to shepherds either to Al Asabaa or Al Orban who can search for grazing lands mainly in the Ghibla where pastures and perennial water resources are available for sheep and goats( Plate 42)

Estimated livestock numbers in Garian, 1957-58.

	<u>Numbers</u>	<u>Percentage</u>
Goats	44,894	53.5%
Sheep	27,343	33.4%
Camels	4,762	5.9%
Donkeys	3,905	4.9%
Cattle	1,267	1.8%
Horses	321	0.5%
Totals	<u>82,492</u>	<u>100.0%</u>

Goats (Fig.49 ) form 53.5% of the total number of livestock and are found in all zones of the region but especially in Al Orban and Al Asabaa. In the other areas, goats are of less importance in the family economy. The distribution of goats in the Jebel is as follows:

FIG.49. DISTRIBUTION OF GOATS



<u>Mudiriyat</u>	<u>Number of herds</u> <u>1957-58</u>	<u>Percentage</u>
Beni Daud	5,712	12.8%
Beni Khalifa	4,702	10.5%
Beni Nser	3,133	6.9%
Al Guasem	5,315	11.9%
Al Asabaa	11,448	25.5%
Al Orban	14,584	32.5%
Totals	<u>44,894</u>	<u>100.0%</u>

The highest number of goats is found in both Al Orban and Al Asabaa, due to the extensive areas of grazing land which are found in these zones, whilst the pastures are limited in the other Mudiriyats. Although Beni Daud ranks third in the number of goats, its livestock is grazed mainly in Gattis land by Araifa and Mtninin shepherds.

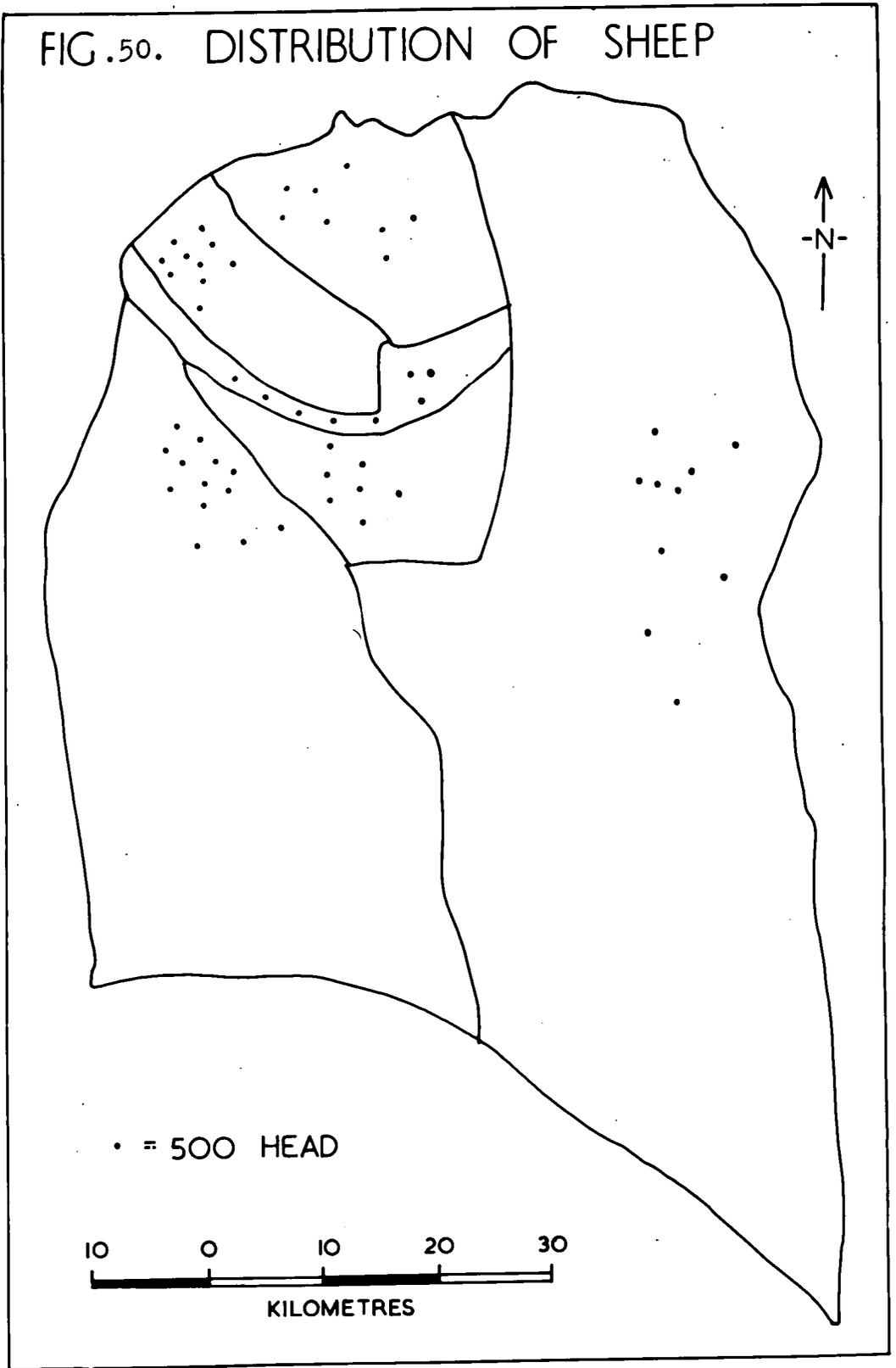
The Jebel goats appear to be extremely abuse-resistant. Moreover, they can feed on shrubs and prickly bushes which sheep will not eat. The goats therefore mix with the flocks of sheep and lead them to the deep Ghibla land, where they serve as leaders because their speed is greater and because of their ability to find good pasture. As a result of these advantages, the semi-nomads in particular tend to own more goats than sheep. In addition, both sedentary and semi-nomadic tribes can benefit from goats' milk and meat for home consumption. Furthermore, goats are very useful for semi-nomadic in particular, because they use goats' hair and skin for making tents and for other

necessities of pastoral life. In general, they are highly esteemed because they are more resistant to the rigorous climatic conditions which prevail in the southern zone of the region. Sheep (Fig. 50 ) are also an important source of meat, wool, milk and skins. The Jebel tribes keep sheep for cash rather than consumption. The number of sheep in 1957-58 is 27,343 and they were 33.4% of the total number of livestock. Their distribution in the Jebel differs from one Mudiriyat to another.

<u>Mudiriyat</u>	<u>Number</u> <u>1957-58</u>	<u>Percentage</u>
Beni Daud	4,955	18.1%
Beni Nser	3,954	14.5%
Beni Khalifa	3,602	13.6%
Al Guasem	4,188	15.3%
Al Asabaa	6,350	23.2%
Al Orban	4,294	15.3%
Totals	<u>27,343</u>	<u>100.0%</u>

The largest number of sheep is found in Al Asabaa, where there are extensive areas of better grazing land. Beni Daud comes next, though the tribes of this section of the Jebel are sedentary people. They hand over their animals in fact mainly to Araifa and Mtanin shepherds who graze livestock professionally. As far as Al Orban is concerned, it comes third in spite of the existence of a vast grazing zone in the eastern part of the Jebel. This may be due to the fact that the semi-nomads there prefer goats to sheep as they are better adapted to the more

FIG.50. DISTRIBUTION OF SHEEP



mountainous terraines. The other areas, Beni Nser and Beni Khalifa, for example, have roughly the same number of sheep; this is due to some extent to the difficulty found by those people in grazing their livestock in the Ghibla land.

Sheep require greater attention than goats as they are more sensitive to climatic conditions and need good grazing land and perennial water resources. The southern zone of the Jebel is used for pastoralism during winter, whilst the northern zone is favourable for grazing in summer.

The Jebel sheep are Barbary sheep, whose characteristics are superior to the other types of livestock found in Libya. They offer a desirable basis for possible improvements in the quality of sheep. The physical characteristics of the Barbary seem to have resulted largely from the rigorous selection imposed by nature. These sheep are generally rather well developed animals of small or medium size, approximately 60 to 75 centimetres in height, with mature ewes weighing 35 to 40 kilos. and rams 40 to 60 kilos. Moreover, Barbary sheep have a large lump of fat in their tails so that they can withstand the hot and arid climate. This type of sheep requires much less drinking water than improved breeds of sheep, and has adapted itself to great variations in grazing and nutritional conditions. On green pasture, the sheep thrive and fatten without access to drinking water, while in the dry season, when grass and other nutritious plants are no longer available, the sheep can be maintained on the coarse scrub if watered at intervals of two

or three days. This is certainly an important characteristic in a region where there is usually an acute shortage of natural forage and water in summer months, during which time the movement of flocks is strictly dependent upon the possibility of watering them.

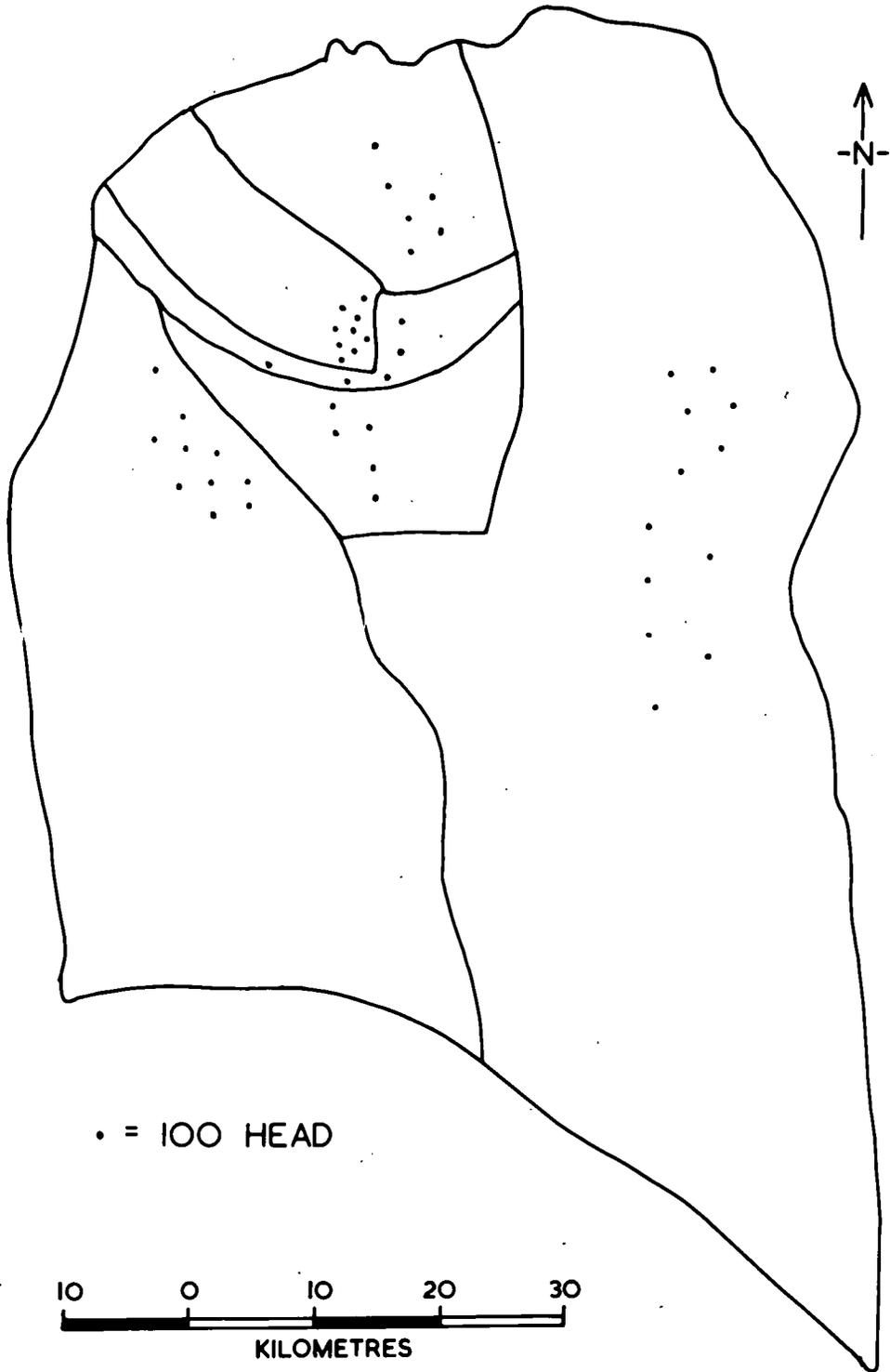
The quality of Barbary wool varies considerably within individual fleeces as well as between sheep of the same flock and from one flock to another. Some Jebel sheep produce as much as 4 or 5 kilos. of wool whilst others yield only 1 to 2 kilos.

Generally speaking, all Jebel sheep-breeding depends on seasonal migration. In winter and spring pastoralists follow the development of the vegetation of the Gattis and the Ghīḍla. In summer, the temperatures are too high in both these zones and therefore the pastoralists are forced to migrate to the north where a little grass and water are available.

However, lack of continuous fodder and the prevalence of parasites are the two outstanding drawbacks in sheep-raising in the Jebel, and a further policy of improvement in sheep husbandry needs to be established. Thus there can be no improvement of any stock unless each individual animal is healthy and well fed. The selection of breeding stock is carried out by the pastoralists themselves with little regard to any laws of breeding.

Camels (Fig. 51 ). Most of the Jebel camels are very important for draught purposes and as pack animals. The number of camels

FIG. 51. DISTRIBUTION OF CAMELS



in 1957-58 was 4,762 or 5.9% of the total livestock in the Jebel. Their distribution was as follows:

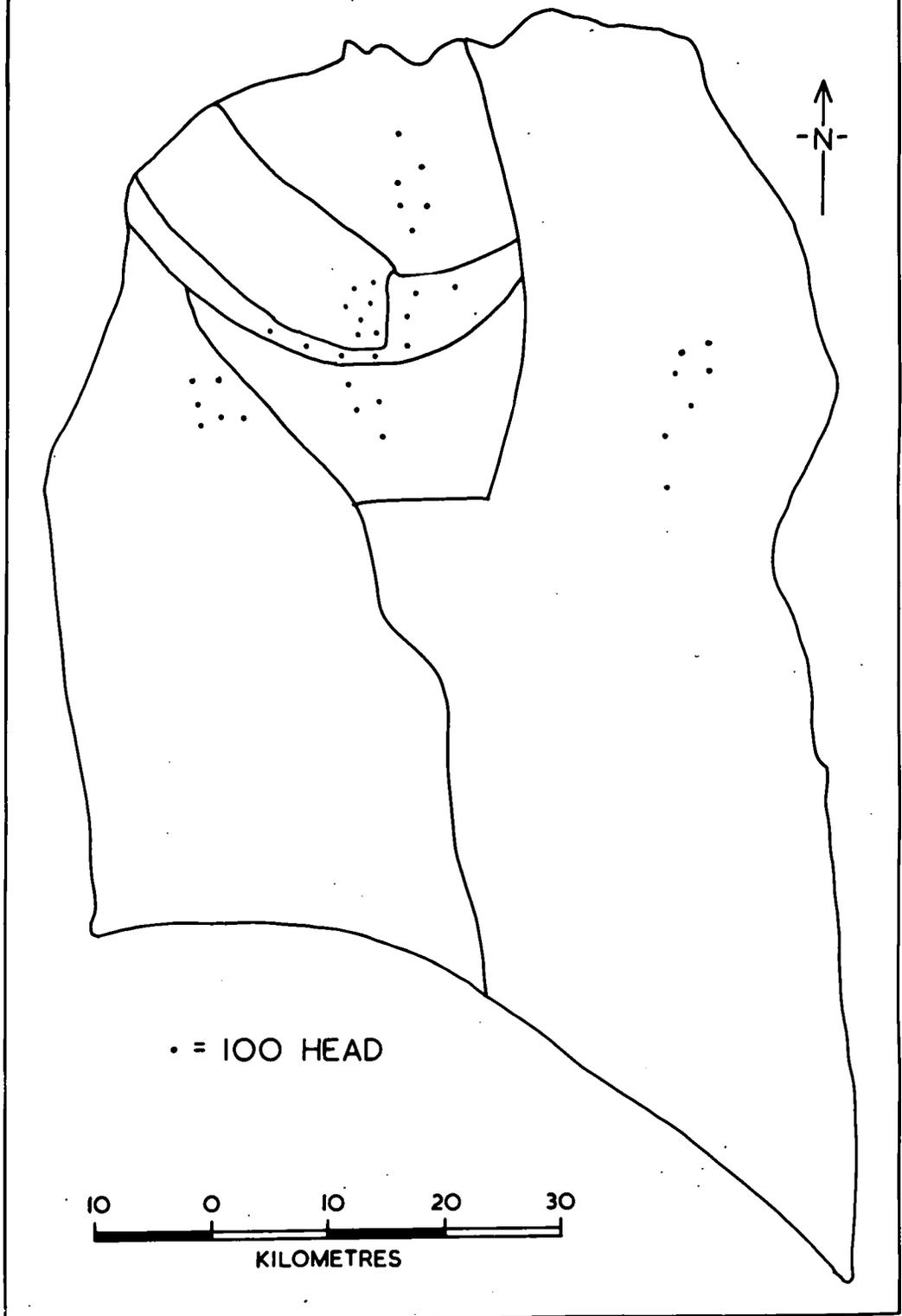
<u>Mudiriyat</u>	<u>Number</u>	<u>Percentage</u>
Beni Daud	865	18.5%
Beni Nser	510	10.6%
Beni Khalifa	500	10.4%
Al Guasem	649	13.6%
Al Asabaa	1,025	21.6%
Al Orban	1,215	25.3%
Totals	<u>4,762</u>	<u>100.0%</u>

Most camels are concentrated in Al Orban, Al Asabaa and Beni Daud. These concentrations reflect the distribution of grazing land and the fact that camels are regarded in those areas as the only means of transport which can be utilized for travel between the deep Ghibla and the northern zones of the Jebel and vice versa. In other parts of the region the inhabitants use camels for draught purposes whether they are in Gattis, Ghibla or in the small gardens of the sedentary people.

The Jebel camel belongs to the heavy built type called locally (Jemal Tghil) (Plate 43 ). Camels are also important as a source of milk and meat. Camel meat is of special importance during the winter seasons and it is mainly consumed by the lower income classes.

Donkeys (Fig. 52 ) are common throughout the Jebel. The number of donkeys in 1957-58 was 3,905 or 4.9 per cent of the total

FIG. 52. DISTRIBUTION OF DONKEYS



livestock in the region and was distributed as follows:-

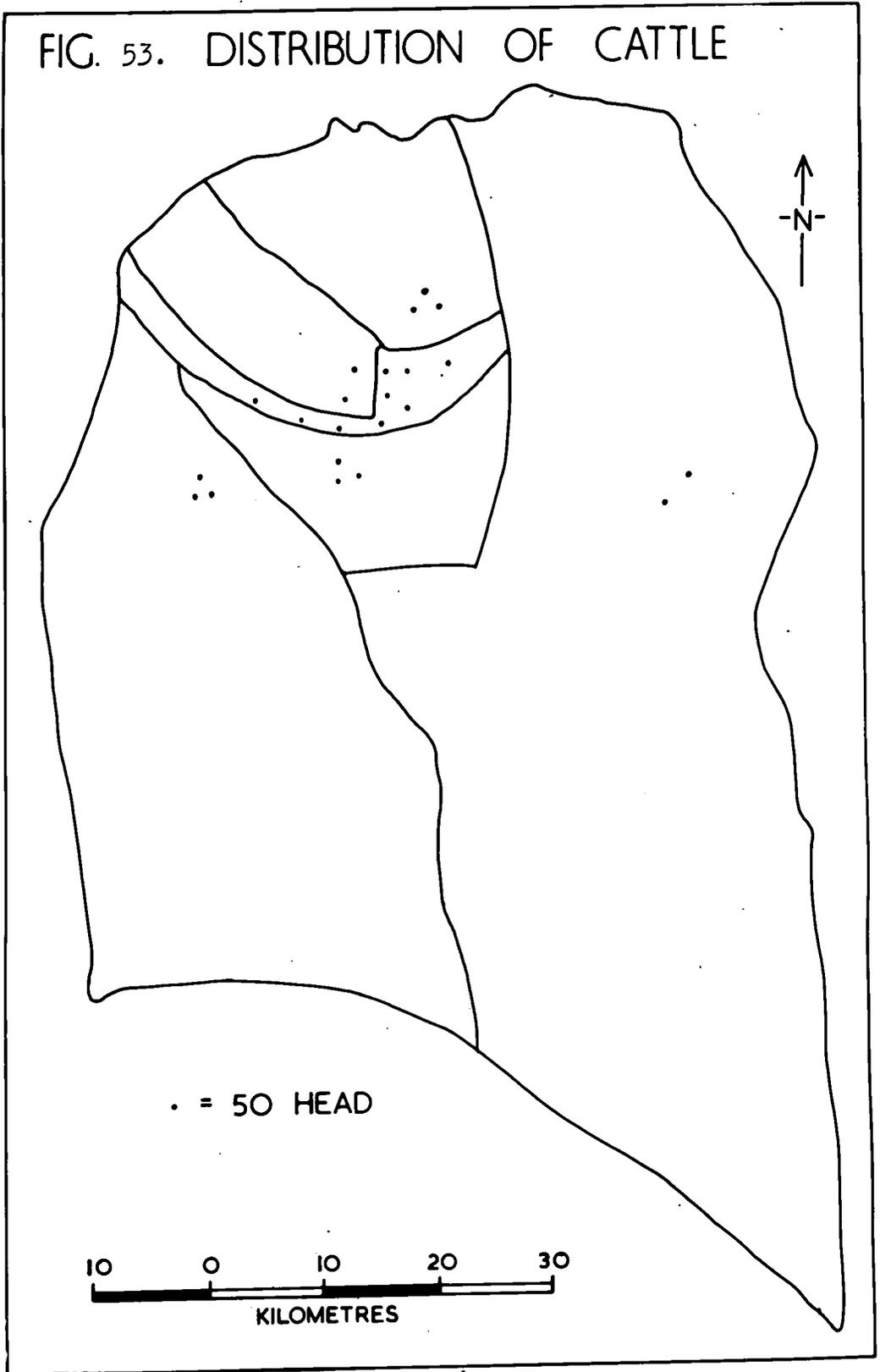
<u>Mudiriyat</u>	<u>Number</u>	<u>Percentage</u>
Beni Daud	676	17.3%
Beni Nser	821	21.4%
Beni Khalifa	449	11.2%
Al Guasem	629	16.6%
Al Asabaa	594	15.2%
Al Orban	736	18.3%
Totals	<u>3,905</u>	<u>100.0%</u>

Beni Nser and Al Orban have the greater proportion of donkeys although they are quite numerous elsewhere. Despite their small size, donkeys are by far the most important means of transportation, being the principal pack and riding animal in the rural areas of the Jebel. They are used extensively for transporting agricultural products from the farm to the local market in Garian town. The donkey is also useful for both semi-nomads during their movements between the Jebel and Gattis and Ghibla, and for sowing or harvesting cereals. Furthermore, the poor people use donkeys for draught purposes on their small parcels of land.

The Jebel donkey belongs to the indigenous Libyan breed, dark in colour and small in size. It can carry on its back loads exceeding two hundredweight.

Cattle (Fig. 53) are one of the most important kinds of livestock kept in the Jebel. The number of cattle in 1957-58 was 1,267 and they form 1.8 per cent of the total number of livestock in

FIG. 53. DISTRIBUTION OF CATTLE



the region, distributed as follows:-

<u>Mudiriyat</u>	<u>Number</u>	<u>Percentage</u>
Beni Daud	114	8.8%
Beni Nser	442	34.8%
Beni Khalifa	144	11.2%
Al Guasem	292	23.0%
Al Asabaa	135	10.6%
Al Orban	140	11.6%
Totals	<u>1,267</u>	<u>100.0%</u>

Beni Nser and Al Guasem have the most cattle, as they have permanent pastures, for instance, Alfa in Wadi Nakhle (Al Guasem) and Slahat (Beni Nser) and perennial water supplies. The main purpose of keeping cattle in these two areas is to work in the gardens and to lift water from wells. In addition, cattle can produce milk for home consumption. In other parts of the Jebel such as Beni Daud and Beni Khalifa, the inhabitants keep cattle mainly to produce milk for children. Neither Berbers nor Arabs breed cattle for killing, and cattle are very rarely used for ploughing. The reason for the existence of so few cattle in the Jebel is that cattle require good pasture and permanent water.

The local cattle are of the same type which are found over the whole of North Africa. They are a small, horned, hardy and light red. They can produce 50-100 gallons of milk, when pastures are good. The Italians introduced the Pantellarian breed from the Island of Pantelleria. It is very hardy and disease-resistant, and would appear to be suited to the local

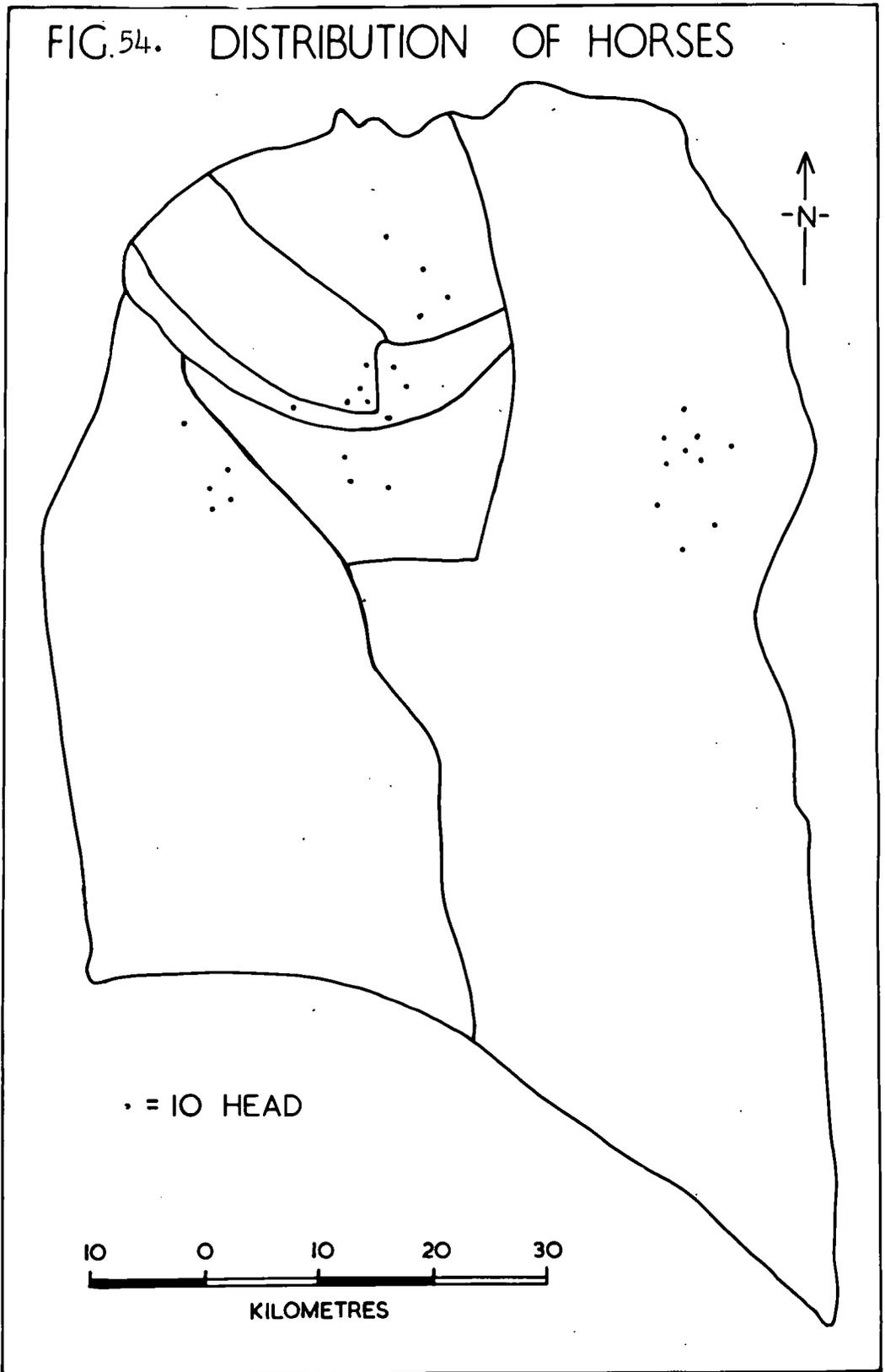
environment of the Jebel. The Pantellerian breed is capable of giving 600 gallons against the local, which gives only 100 gallons. Moreover, the Italians crossed the Pantellerian with the indigenous cow and the resultant breed was stated to have withstood the harsh conditions of this semi-arid region of Tripolitania. (16)

Horses (Fig. 54 ) are much prized, but they are not numerous. This is partly explained by the fact that their nutritional demands are less easily satisfied than those of the camel for draught purposes. On the other hand, the horse is a very useful animal on the Italian farm. It is used for agricultural purposes, drawing carriages and riding. The horse is as fully used by the Italians as the camel by the native. The number of horses in 1957-58 was 321 or 0.5 per cent. of the total number of livestock in the region, and distributed as follows:-

<u>Mudiriyat</u>	<u>Number</u>	<u>Percentage</u>
Beni Daud	41	12.8%
Beni Nser	44	13.4%
Beni Khalifa	26	8.2%
Al Guasem	57	17.8%
Al Asabaa	46	14.4%
Al Orban	107	33.4%
Totals	<u>321</u>	<u>100.0%</u>

Their concentration in Al Orban reflects the existence of semi-nomadic tribes which use horses for riding. Al Guasem comes next owing to the existence of good pasture land and a permanent

FIG.54. DISTRIBUTION OF HORSES



water supply in Wadi Nakhlæ. The rest of the areas have roughly the same number of horses. Both Berbers and Arabs consider the breeding of horses as a luxury and therefore the owners of horses are normally wealthy people. The Jebel horse is mainly descended from the ancient Berber breed which produces the best army horses.

### Fluctuation in Stock numbers

The number of livestock in Tripolitania in general and the Jebel Garian in particular has fluctuated considerably in the course of the past fifty years as a result of war, local unrest, droughts and political changes. During times of war the number of livestock can decrease in many ways, local unrest leads to neglect of watering places, lack of security and general decadence in the industry. Droughts were recorded in the years 1897, 1907, 1915, 1935-36, 1947-48 and 1954 of which those of 1897, 1936 and 1947 are generally considered to have been the worst. In addition, during the years of drought a certain number of Garian tribes migrated with their herds to Tunisia, hoping to find grazing land for their animals. Moreover, the Italian colonization schemes deprived the native of much available grazing land and even more important, access to reliable water supplies. (17)

### Methods of improvement

The first step to improvement must be an adequate and reliable provision of water and the availability of permanent grazing lands which would provide fodder for the livestock not only for a few months but for the whole of the year. This step could be made by surveying all the water resources in the Jebel and

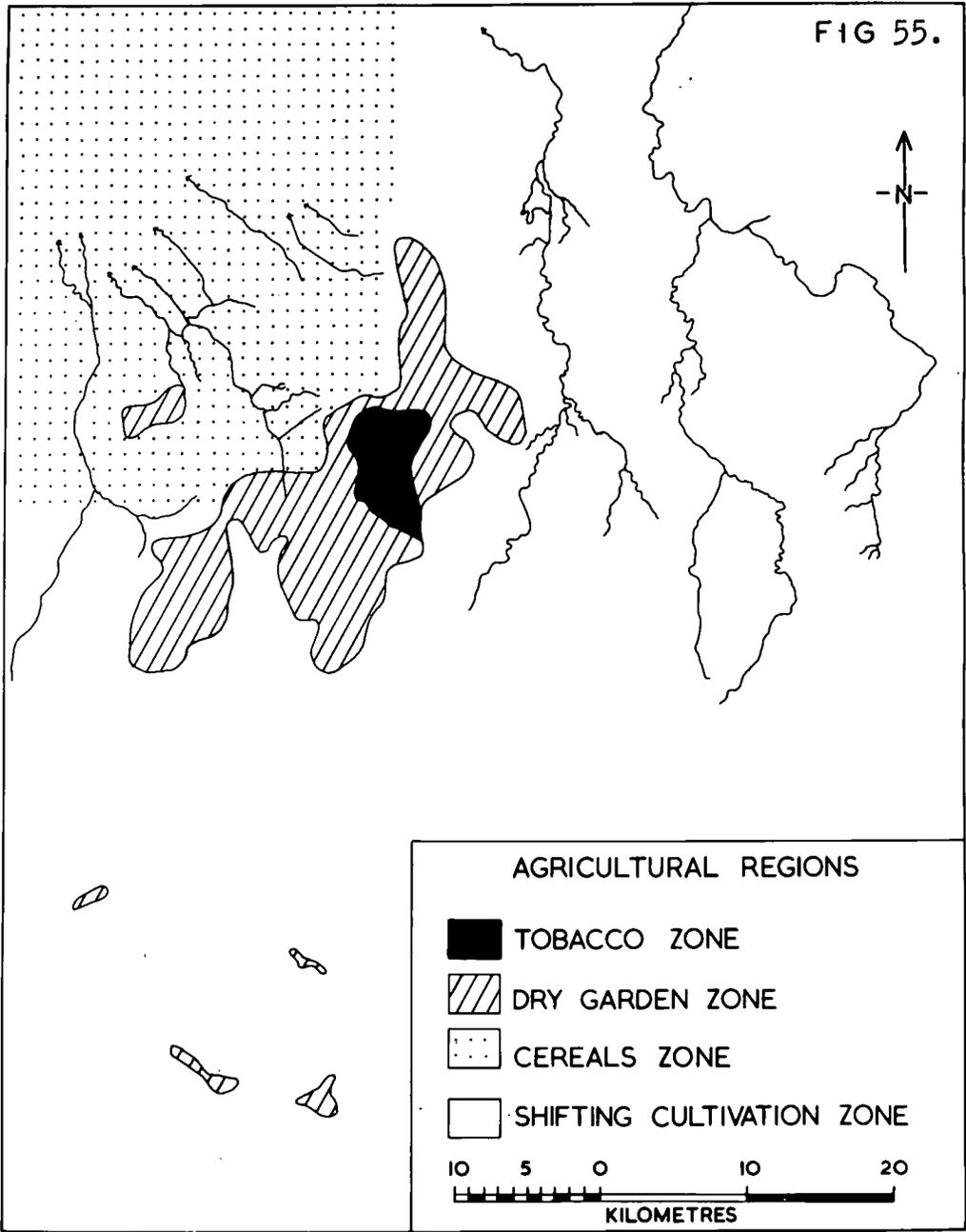
by encouraging the population to repair the old Roman cisterns which are very numerous throughout the region. On the other hand, people must be encouraged to grow carob trees (*ceratonia siliqua*) and other useful plants such as spineless cactus etc., in order to feed their livestock during the years of drought when the grazing land in both Ghibla and Gattis is limited and cannot support the livestock. The cultivation of millions of carobs could be achieved in the more humid zone of the Jebel in order that animals might survive when grazing land is insufficient.

Secondly, the Government should abolish the tribal rights to grazing land in Ghibla and Gattis so that the whole population has equal right to graze their livestock. The third step could be fulfilled by an improvement in both the quality and quantity of livestock production. This would be likely to increase the importance of this economic source by creating a more discriminating market in Tripoli for the Jebel livestock products. This step may be explained further by improving the health of livestock and by preventing diseases in order to protect animals. Moreover, there is a further possibility, namely the improvement of local breeding methods by the establishment of one mixed farm in each Mudiriyat in the region to breed better and healthier livestock, which could withstand the rigorous climatic conditions in the years of drought.

#### AGRICULTURAL REGIONS

The Jebel Garian may be divided into four agricultural zones. (Fig. 55)

FIG 55.



1. Dry garden farming includes the Mudiriyats Al Guasem, Beni Dand, Beni Nser, Beni Khalifa and the northern section of Al Asabaa.
  2. The tobacco zone occupies a vast area in Tigrinna.
  3. The Gattis or cereal zone is situated to the north-west of the Jebel.
  4. The Grazing and shifting cultivation zone covers over an extensive area to the south of the Jebel.
1. The Dry Farming zone occupies 51.5 sq. kilometres or 11,027 hectares. This zone includes all the dry gardens whether they are owned by Berbers or Arabs. The main crops of this zone are olives, figs, almonds, peaches, apricots and vegetables. Moreover in certain areas, cereals are grown on a small scale. Some members of the tribes of this zone own livestock which graze either in Gattis or Ghibla lands.

A good example of this dry farming is the 20 hectare farm owned by Mohammed Abu Rakhis which lies about 12 kilometres south of Garian town. The total number of trees is 2,060 with the following varieties:-

Olives	400
Almonds	800
Vines	800
Peaches	30
Apricots	15
Apples	15

The farmer cultivates winter and summer vegetables such as cabbages, tomatoes, green pepper etc. Cereals are grown between the trees, also in Gattis and in the Ghibla he has a considerable

number of goats (80) and sheep (50).

2. The tobacco zone includes all the ex-Italian farms in Tigrinna. This zone is restricted to the most fertile areas of the Jebel. The estimated area of this zone is 1,458 hectares, of which 1,200 hectares are cultivated. Tobacco is the major commercial crop. There are 356 farms, varying in size between five and two hectares, but the larger farms are found in the southern section of the ex-A.T.I. Estate, whilst the smaller ones are located to the north.

A typical five hectare farm is that owned by Mohammed Meld Ibrahim. The farm number is 348. The total number of trees is 127:

Olives	70
Peaches	4
Almonds	40
Pomegranates	7
Figs	6

The cultivated area in tobacco is two and a half hectares. Wheat occupies two hectares and a half hectare is devoted to different types of summer and winter vegetables. The farmer has 15 goats and 10 sheep.

3. Gattis or cereal zone. This zone covers 1,000 hectares approximately. Wheat and barley form the major crops of this zone. Most of the Jebel tribes own specific parcels of land. The cultivators, whether Berbers or Arabs go down at the beginning of winter to sow cereals in Gattis, and again at the beginning of

summer for harvesting.

This zone contains the most fertile alluvial soil in the region, since the various wadi deposits are spread out over this area. Thus the soil renews its fertility every year, and the cultivation of cereals is very successful when there is adequate rainfall.

#### 4. Grazing land and shifting cultivation

This zone involves the whole of the Mudiriyat Al Orban and the southern and central sections of Al Asabaa, and its estimated area is 22,700 hectares. Its predominant physical features are the gentle slopes down towards the deep Ghibla. The vegetation cover includes esparto, zizyphoes lotus etc., which are the major fodder for livestock. Although grazing is the principal form of activity in this zone, the semi-nomads of both Al Asabaa and Al Orban also practise extensive shifting cultivation of barley and wheat. The semi-nomads, however, have no specific cultivation areas, but any land in the Ghibla that has benefited from rainfall is favourable for the growing of cereals.

#### PROBLEMS OF AGRICULTURAL DEVELOPMENT.

In conclusion, it may be said that there are many problems facing the future agricultural development of the Jebel Garian. The sedentary peoples of Al Guasem, Beni Dand, Beni Nser, Beni Khalifa do not possess sufficient land for their needs in the Jebel areas. The numerous dry gardens must be preserved for arboriculture so that the people will be forced to practise

shifting cereals cultivation either in Gattis or the Ghibla. The search for other lands is particularly intensive at the present time. Again, in the western areas, steep slopes restrict the amount of cultivable land, which is concentrated in the large wadis.

In an arid region which in many respects is only of marginal quality for many crops, good ground water resources are essential for development. Such resources do not exist on a large scale in Garian so that agriculture must rely on rainfall and efficient means of collecting and utilizing the same. In Garian, the rainfall varies in volume and reliability each year and there is probably at least one year of drought in every five. Consequently, agricultural production fluctuates immensely and such fluctuation can undermine incentive and marketing possibilities.

Shifting cultivation and pastoralism often result in the loss of potentially cultivable land to stable and more productive agriculture. In Al Asabaa and Al Orban, there are large stretches of land, particularly in the north, suitable for olive and tree cultivation but owing to the tribal system they remain out of continuous cultivation.

Agricultural development is also hampered by the basic ignorance of modern and more efficient techniques of cultivation. The inhabitants of the Jebel Garian still rely on old and inefficient ploughs, primitive tools, and outmoded ideas with regard to fertilization, rotation of crops, irrigation, and harvesting. Such methods can be improved by education and

greater extension facilities but it will be a slow and painful process.

### Future of the Italian farms

The final problem concerns the Italian farms. During the British Military Administration of Libya, the rights of the Italian farmers were maintained and guaranteed. However, with the signing of the Italian-Libyan treaty in 1956, the Italian settlers were given the choice of either staying on their farms or handing these over to the independent Libyan Government. As a result, 90% left.

These farms are now mainly in the hands of the local Berber population, and the chief problem facing the Government is how these new farmers can manage without the advanced technical knowledge of the Italians and without the generous subsidies that the Italian Government provided in drought years. The main crop is tobacco which requires careful attention at all stages. However, the Tripolitanian Administration is taking steps to maintain standards and equipment in good order, and to improve the land of the farmer. Furthermore, the State Tobacco Monopoly can withdraw the farmer's licence to cultivate this crop if his standards are poor. However the Government does not provide any help in the case of failure - a factor which causes anxiety amongst the farmers.

These are the chief obstacles to further progress. Their solution is difficult to envisage without a substantial increase in all types of education, but especially in the teaching of agricultural techniques. A start has been made, but there is much to be done.

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## CHAPTER X

### INDUSTRY

Most of the industries of the Jebel Garian are small in extent and are mainly related to agriculture. Two of these are oil-pressing and flour milling. Both modern oil pressing and oil pressing by means of animals are found and Figure 56 shows their distribution in Garian. The modern oil-press was established to serve the Italian farmers in Tigrinna. It can produce a better quality oil, although the oil is still below the standard required in Europe. Much of it is exported to Italy for refining. The primitive oil-presses are operated by the Jebel owners and they are located mainly in the sedentary agricultural areas. AS a result of poor methods and the lag between harvesting and pressing, during which the acidity of the fruit increases, the oil obtained is highly flavoured with a high acid content.<sup>(1)</sup> These qualities are distasteful to most non-Libyans but the local population prefers this oil to the relatively tasteless oil in favour elsewhere. However, the production in the oil presses is restricted during harvesting (October to November). (Plate 44).

As regards the flour-milling, there are a tremendous number of machines in existence in various places and they work by Diesel powered mobile units. Their distribution in the Jebel is shown in Figure 57. There are on an average at least four flour millers in each administrative unit (Mudiriyat). The activity of those millers in the whole year is continuous but it increases during the

FIG. 56.

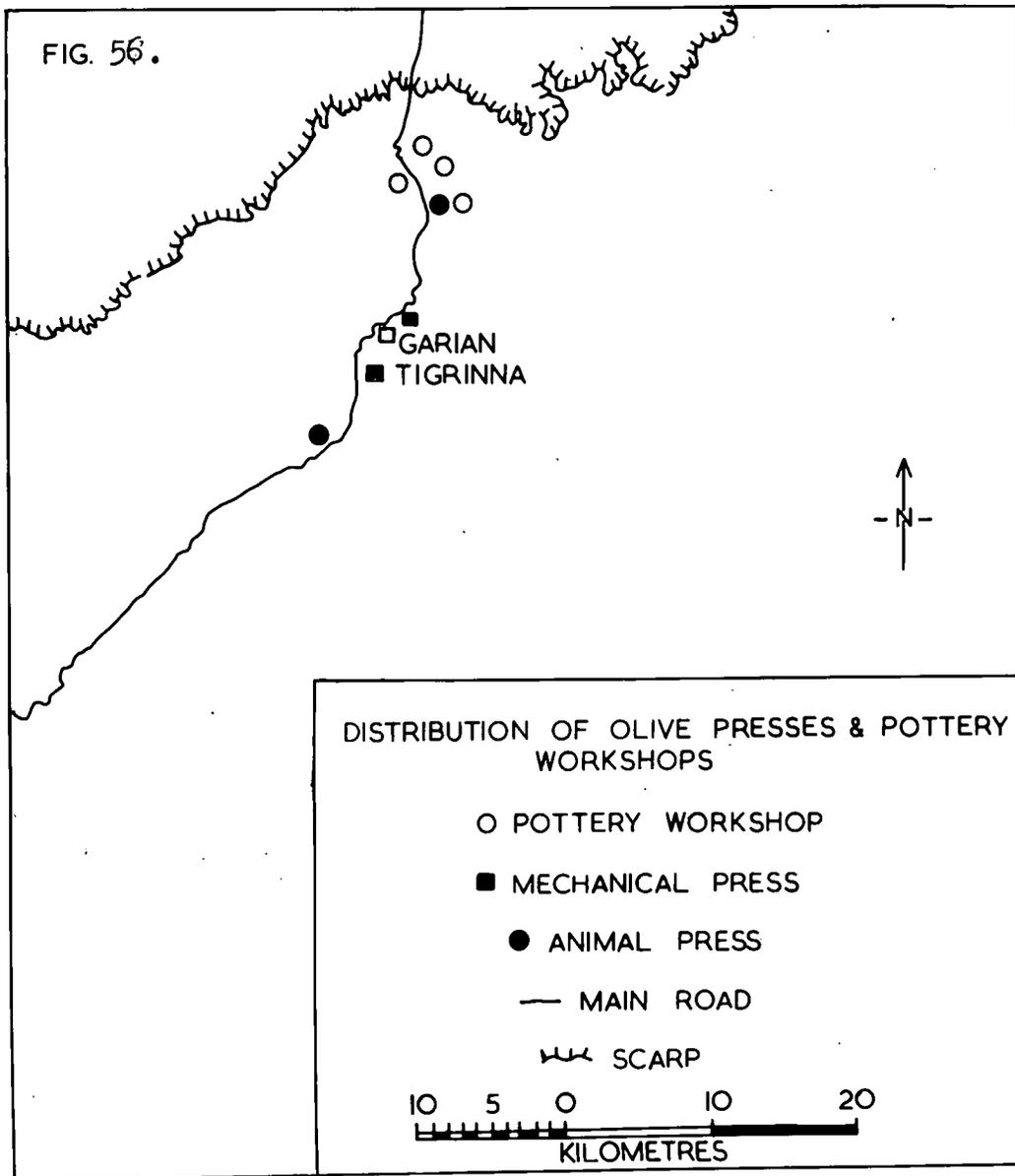
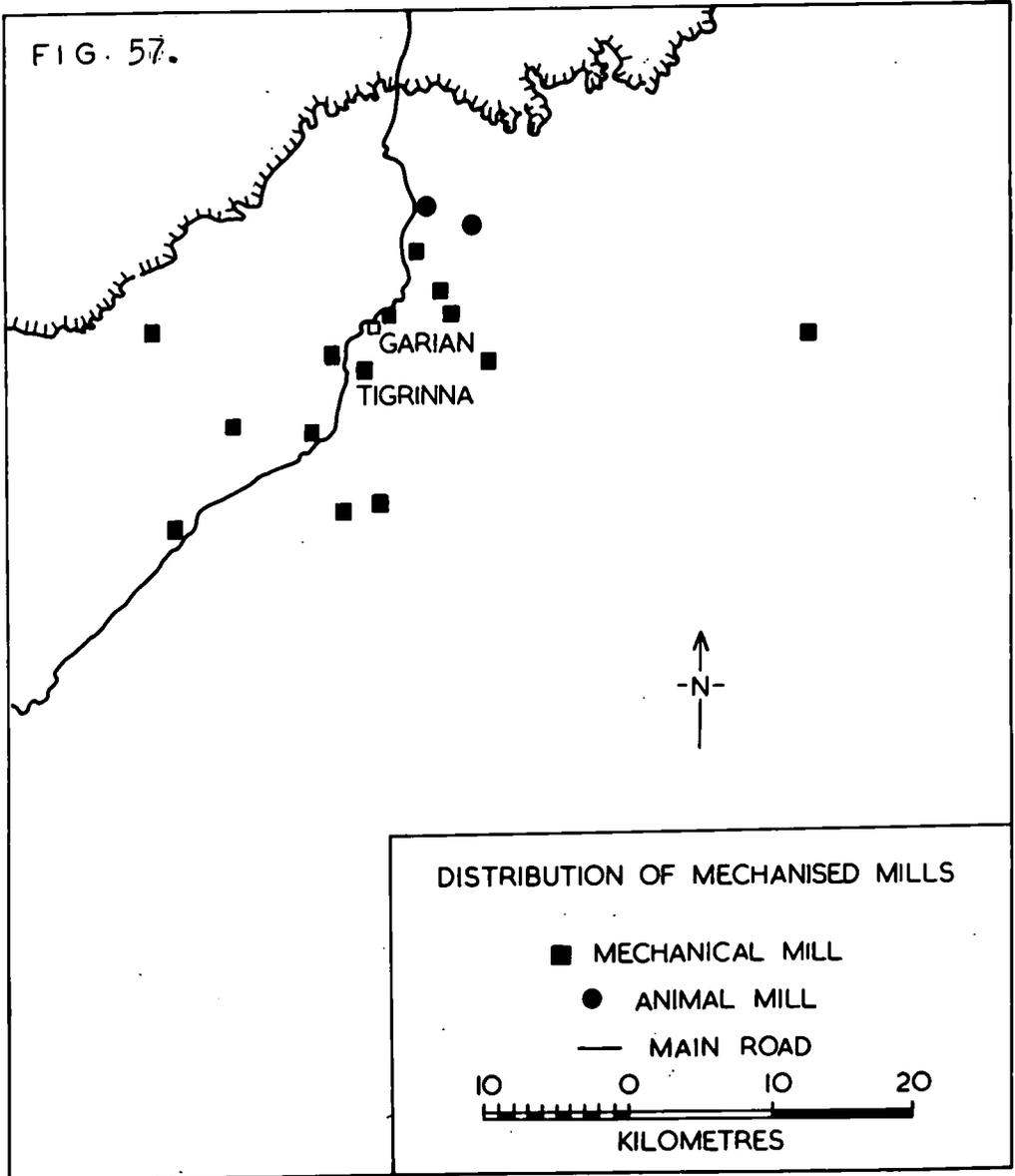


FIG. 57.



summer when the people finish harvesting.

Another interesting local industry is the manufacture of pottery, which exists in four tribes: Miamin, Abgar, Bu Slama, and Rahba. (Fig. 56 shows their distribution). This industry is restricted to four places only in Guasem, owing to the availability of clay materials in Bu Gheilan, and Khusha (to the east of Wadi Gan). The people here produce the pottery in small workshops (Plate 45) and have provided this commodity for generations. However, these potters generally produce most of their work for domestic purposes, although certain pottery is produced for other purposes. The Jebel Garian has a remarkable reputation as a result of this local industry, and a large amount of pottery is sent every year to Tripoli and the major Libyan towns. There is nothing in fact better than pottery which can keep water fresh and cool during the hot summer. (Plate 46)

The production of pottery varies from place to place, but the highest production occurs in Miamin which can produce one thousand pieces of pottery during the season of work (summer and autumn). The workshops stop producing pottery throughout the winter and spring owing to difficulties of the cold weather and absence of central heating in the workshops.

Quarrying is another aspect of primitive industry which is found in the Jebel. There is only one quarry in the region located to the north-east of Garian Town. The industry of producing pater shaped lime-stone rocks was particularly active

a long time ago; but at the present moment there is a decline in this industry owing to a lack of desire on the part of the Jebel people to use stones for building. During the Italian Administration, this industry was in great demand and was therefore very active owing to the stones being used for building the farm houses in the Tigrinna Estate and Garian Town. The stone was also used to construct the houses of the Administrative Officers.

However, this industry can be encouraged again if the population desire to live in houses instead of troglodyte dwellings which are in the opinion of the writer not as good as the stone houses from the point of view of hygiene.

Apart from the local industries is the handicrafts which are usually carried out by women in houses. Of these, perhaps the most common one is the manufacture of the Holi-barracan which is used for men wearing and as blankets.<sup>(2)</sup> This industry is carried out by poor families. These families buy the raw wool, wash it, weave it and make into barracan. The usual profit of making one barracan is very small and never exceeds three to five pounds in spite of the fact that it takes no less than a month to make it. Another similar handcraft is the making of tents which is quite common in both Orban and Asabaa. There is in fact much similarity in the methods of making of both tents and barracan, except for the difference in the raw materials, as tents are generally made from goats hair. These two handicrafts are as mentioned already, carried out by women.

Other handicrafts are the making of wood ploughs and tools for agricultural purposes, blacksmithing and shoe making in small individual shops in Garian and Tigrinna. Charcoal is in great demand due to its extensive use for both cooking and making Shahi-tea. The wood of the one adult olive tree produces approximately one ton of good charcoal. The method used is by cutting the wood into pieces, putting it inside a small pit, lighting and covering it with clay. After two to four days and when the whole amount is burned they open the pit, take the charcoal and expose it to the weather for a few days until it is dry and ready for use.(3)

Generally speaking, most of the Jebel industries as we have seen, are either relying on agricultural products or primitive ones, and the only possibility of industrialization is the improvement of the modern oil pressing and flour milling. By these means, it would be possible to increase the production of pressed olive oil and establish another factory for refining olive oil. In addition, it would be possible also to add new industries to the Jebel, depending upon both the production of cigarettes and fine papers for tobacco and Esparto. These attempts could be done if there were the necessary capital and investments.

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## CHAPTER XI

### COMMUNICATIONS

The position of the Jebel Garian in the central part of the Tripolitanian escarpment has significant value for the routes which link Tripoli with Garian and Fezzan. Thus the Jebel routes have played an important part during the Arab and Turkish rules in Libya. The most important routes are those which link Garian with both Mizda and Nalut. Moreover, the exchange of goods between the Jefara Arabs and the Jebel Berbers followed the main track via Vertice at the escarpment. This route was used extensively during the eighteenth and nineteenth centuries by the caravans, when the exchange of goods between Nigeria and Tripoli was very active.<sup>(1)</sup> The quality of these routes as a whole was not good, except those which had been constructed by the Romans between Garian and Mizda.

The various routes which run through the Jebel can be divided into the following classes according to their quality. In the first class category is the main road which links Tripoli with Nalut and Gadames. This route is the most important one in the Jebel, and was constructed by the Italian army at the beginning of 1922 in order to transport military supplies and arms which could be used against the uprisings which threatened the Italian administration.<sup>(2)</sup> The Italian Government spent millions of liras on the construction of this road, particularly at Bu Gheilan where the slope of the escarpment is very steep (Fig. 58). This route is wide and metal led for seventy

kilometres from Bu Gheilan as far as the administrative boundary between Garian and Yefren. The value of the route was significant both for the Italians and the Arabs as it enabled the expansion of the Italian settlements in the Tigrinna Estate. Furthermore, the Italians constructed several secondary roads through the agricultural lands in both Beni Daud and Beni Nseri in order to serve the needs of the ex-Italian farmers. The roads radiate from Tigrinna village to the north and to the south. Although they are not macadamized they are quite suitable for vehicles. (Plate 47,48).

In the second category is the main route which connects Garian town with Rabtas and the other route which goes down to the deep Ghibla as far as Mizda and the Fezzan (Fig. 58 ). These routes are not macadamized and are usually narrow, but they are quite suitable for mechanical transportation. The Mizda Garian route begins at Bu Zeyyan and runs across the Asabaa plateau and slopes gently down to Mizda. This route was constructed by the Italians also for military and administrative purposes. It has a length of 90 kilometres, and its importance at present is to transport passengers from Garian to Mizda, mostly nomads of Ulad Bu Saif. The importance of the route has declined as the main road to the Fezzan province, since the Federal Libyan Government has constructed a highway via Misurata Bu Ngem and Sebha.

The Garian-Rabta route functioned in the transportation of passengers from the railway station which is located at the foot of the Jebel. Since 1943 this route has also lost its

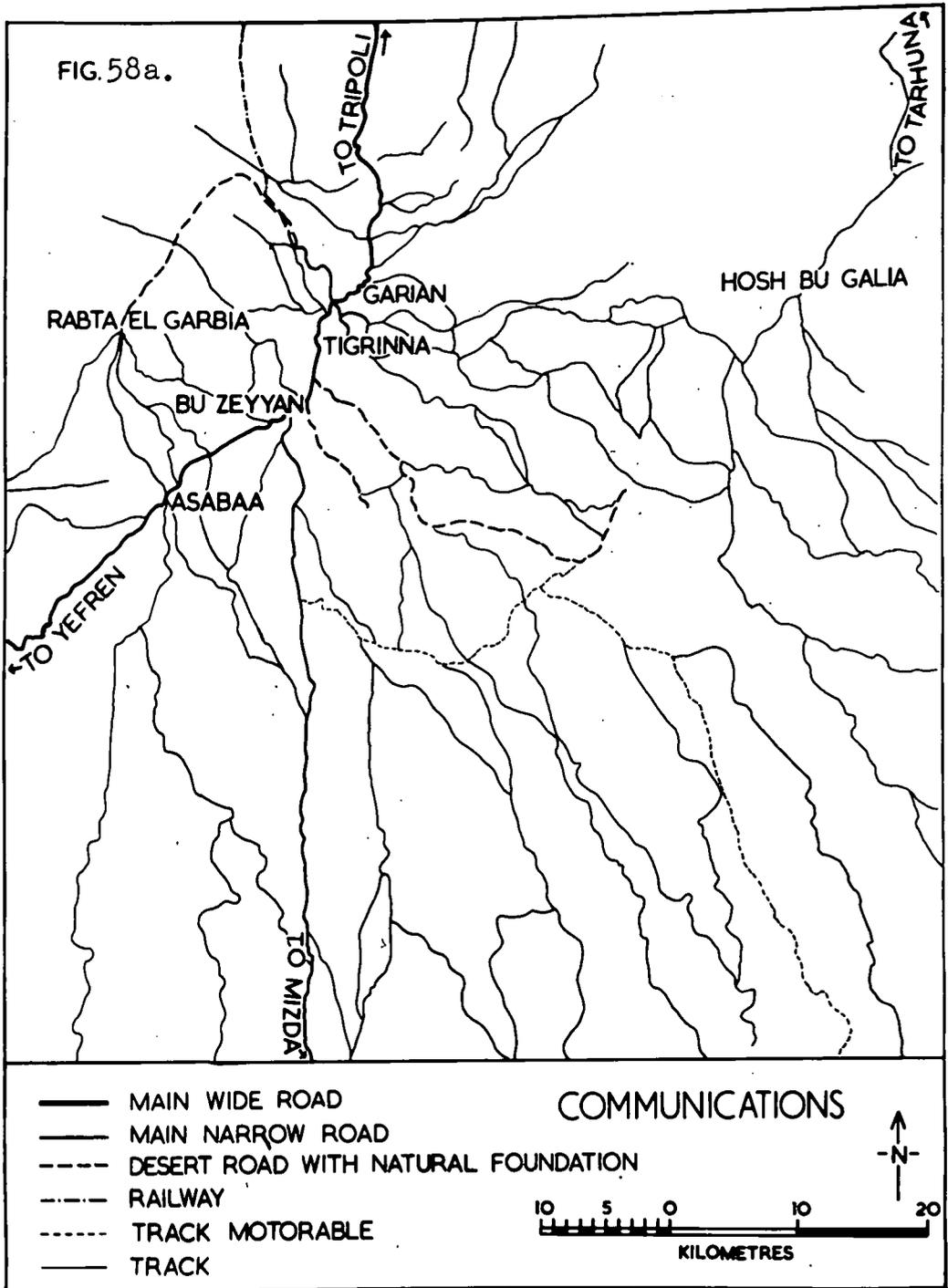
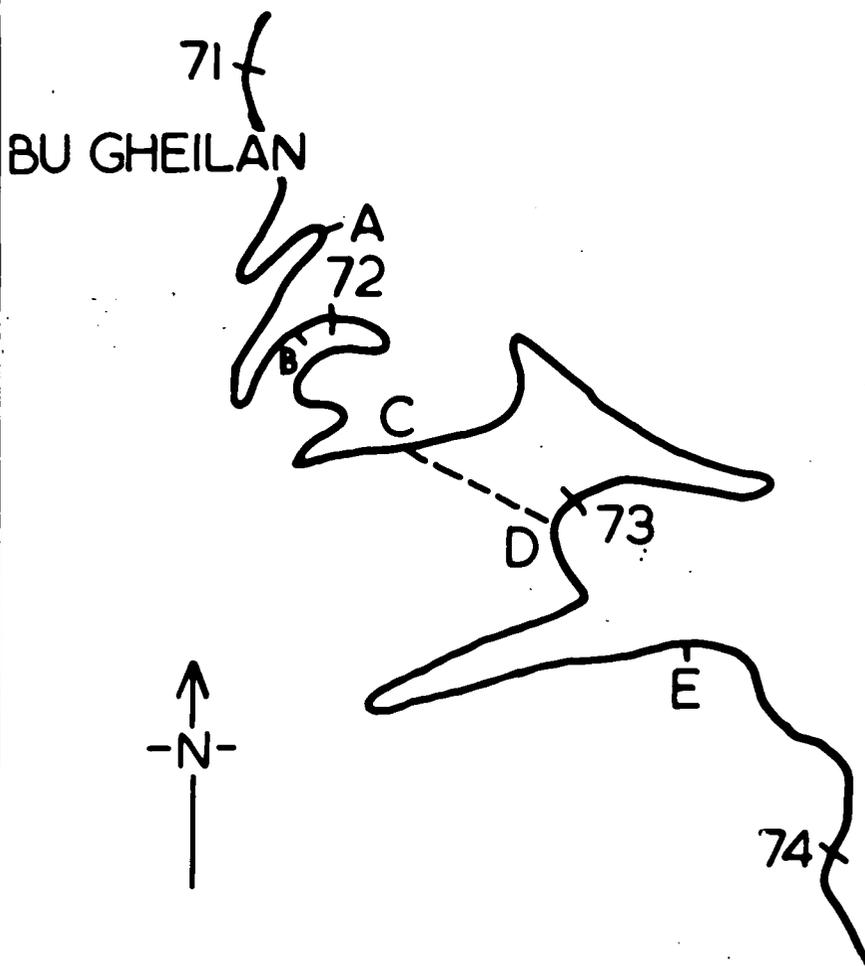


FIG. 58b. SKETCH OF TRIPOLI -  
GARIAN HIGHWAY  
AT BU GHEILAN



significance. At the present time, it has importance to the Arabised Berbers of Ratbas who are mostly engaged in growing vegetables, supplying the Garian market. The farmers use this route very often for transporting their vegetables. There is no bus service on this route.

In addition there is also another road with natural foundation which was constructed recently (1949-59) by the Esparto Company in order to connect Garian with Bir Cur central collection of esparto in Orban.<sup>(4)</sup> This road departs southwards from the Tigrinna Village as far as Bir Cur. The only significant value of this road seems to be in the collection of esparto.

Other motorable tracks have been mainly constructed by the Esparto Company. They are generally smaller than the former, and are concentrated in the eastern and central zones of the Jebel owing to the availability of flourishing esparto grass; whilst the western zone of the Jebel, which is primarily poor in vegetation, has no major tracks built by the company.

The third category of communications comprises the network of lesser tracks or footpaths which link the main routes. Those tracks are rough and narrow and they are fit only for pack animals. They are generally widespread throughout the Jebel and their only significant value is for the pastoralists of both Asabaa and Orban where the routes are used very often during their movements for sowing or harvesting cereals and grazing livestock. The most important one is the track which leaves

from Bu Zeyyan for Gathis (Plate 49), which is used twice only by most of the Jebel people in the year when they go down to Gathis for sowing or harvesting.

Railways have in fact historical value since this route has ceased serving the Jebel people since 1943. This linked Garian with both Azizia and Tripoli and the main purpose of constructing this line was for military and economic purposes.

Therefore, most of the Jebel routes are either non-macadamized or primitive ones which require more attention from the responsible authorities in order to serve the needs of both the sedentary and semi-nomadic peoples.

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## CONCLUSION

Agriculture and pastoralism are the main natural resources of the Jebel people. The Jebel, as an arid zone, depends entirely on precipitation, limited underground water resources and soil potentiality. Precipitation, being unreliable, irregular and often violent, is, in fact, one of the main problems which impedes the expansion and success of agricultural products. Furthermore, the six months of aridity do not enable the soil to maintain its underground water resources, and generalized and localized drought, which occur every four or five years, harm the various crops and encourage the sedentary people to migrate outside their tribes to Tripoli for work. Although there are several springs and wells, they are located mainly at the bottom of wadis, and their potential capacity, being considerably reduced in years of drought, relies to some extent on precipitation. In addition, most of these major underground water resources are exploited for domestic use and not for agricultural purposes. Cisterns in the same way, rely on precipitation, and when rain fails, the ensuing effect on people and animals is disastrous. It is notable that the Italian reservoirs, in spite of their great size, are unable to support the farms in Tigrinna during the years of drought. On the other hand, in years which enjoy a high rate of precipitation the esparto survives, and is a good source of income, especially in Orban. In the dry years, however, when precipitation is low, only a few favoured spots remain, which,

in conjunction with the perennial underground water resources, can maintain livestock. In the years of extreme drought livestock have to be moved from the Ghibla to Cyrenaica, a region, which owing to its pasture and vegetation potentiality, can support both the Tripolitanian and Jebel livestock.

In years of adequate precipitation, considerable quantities of agricultural products can be grown in the Jebel. In times of drought, however, both cereals and crops fail completely.

Precipitation affects the standard of living of both the sedentary people and semi-nomadic tribes of this region. When rainfall is sufficient the people are able to raise their standard of living by selling their agricultural products, cereals and fruit trees. At the same time, livestock tends to be in good condition and can produce considerable cash money for the family, with the result that home requirements can be purchased. Moreover, the problem of unemployment is solved because people can sow cereals in the Ghibla or Gattis, and are able to grow more fruit trees on the land of the Cabila or on the minor terraces on the slopes of the wadis. This allows them to stay at home and work in the garden or graze animals on the pasture.

After the harvest in years of high precipitation, the incidence of marriage among the young people increases, and in many cases it happens that a man who is already married can afford to marry again because of his increased wealth. As a consequence of this the birth rate increases, and the death

rate declines. Moreover, political stability and social security among the people in their own land results in the spread of agricultural education. This can be seen in the case of the semi-nomads of Al Asabaa and Al Orban who tend to send their children to school in years of high rainfall. In years of low rainfall, however, the children are prevented from attending school because the family is obliged to move from place to place in search of winter grazing land.

Migration increases and declines correspondingly with good or bad years. During the years of drought a considerable number of people migrate to Tripoli in order to find work. In many cases they never return to their native region, preferring a higher standard of living. As a result, the Jebel population in 1917 was higher than in 1956. Furthermore, the death rate increases in years of drought when there is a lack of food and water.

Nevertheless, the effects of precipitation on the life of the people in this semi-arid zone can be mitigated to some extent by a hydrological survey of underground water resources and by the construction of large reservoirs for each tribe in order to provide adequate water for agricultural purposes.

Soil erosion is also a serious problem in the Jebel owing partly to rapid run-off and partly to over-grazing and tree-felling. Thus some measures should be undertaken to conserve soil particularly on the slopes of the hills by afforestation. This could be undertaken by the State Department of Afforestation

which could encourage people to grow more trees and prevent livestock from harming plantations. As far as esparto is concerned, some efforts must be made to maintain the esparto fields especially in Al Orban and Al Asabaa and eliminate reckless harvesting. The responsible authority should teach people the best way to harvest this plant, and at the same time some official action must be taken to preserve the esparto areas for livestock during the years of the drought, especially when there is failure of grazing animals in the Ghibla.

In this regional study the human and economic problems of the Jebel must be taken into consideration. The present indigenous settlements, in particular the insanitary troglodyte dwellings in which the population has been accustomed to live for some considerable period of time, portray the low standard of living among the sedentary people who are unable to afford their own modern house. These dwellings also prevent the spread of hygiene and lower the standard of health in the region.

Moreover, the existence of shifting cultivation and pastoralism over wide areas, especially in Al Orban and Al Asabaa, prevents the development of land suitable for agriculture. If semi-nomads could be persuaded to settle by the government, more land could be utilized for agriculture and so prevent the over-population of certain areas, namely Beni Daud and Al Guasem. Therefore the tribal system must be abolished and the whole region must be placed under the direction of a mudir, rather than under that of the various Sheikhs. Unfortunately, the

Italian and Libyan governments failed to consider this problem.

The settlement of semi-nomads would increase agricultural products and help towards the spread of education. Moreover, there would be more social contact between the various peoples. The economic expansion of this region could be achieved by persuading the sedentary people to abandon their primitive ways in favour of the use of more modern techniques in cultivation. One step in this direction has been the establishment of co-operative societies in each mudiriyat which employ modern techniques, whether in the sowing or harvesting of cereals or the use of inorganic fertilizers, especially for growing tobacco and other fruits. A further way of improving the economy would be to construct special farms which could experiment with various trees in order to find out which variety would be the most suitable to resist the arid climate of the Jebel. Moreover, meteorological stations could be established in different parts of the region in order to study the effects of weather on agriculture. In order to preserve the high standard of agriculture introduced by the A.T.I., the Tripolitanian Government must supervise the ex-Italian farms and farm-houses in order that the standard of tobacco cultivation does not decline in the future because of the lack of technical knowledge on the part of the indigenous farmers. Moreover, the Government must give practical assistance in providing the latest equipment, and if necessary, financial support in the case of crop failure. Furthermore, livestock is an important

source of income to the Jebel, and as such must not be neglected. The quantity and quality of the stock could be improved, and if the Government were to concentrate on certain breeds of high quality a discriminators' market could be created for animal products.

As has been seen above, the problem of unemployment is always present due to the unreliability of precipitation. In order to obviate the effects of years of low rainfall the State Tobacco Monopoly must establish another factory in Garian or Tigrinna to employ people who are unable to find employment on the land. Two further means of improving the standard of living would be to establish a factory for producing paper from esparto and a factory to refine olive oil, the olive being the most important crop in the region.

Finally, the primitive communications prevent the quick transportation of agricultural products and weaken the economy of the region. The government must undertake the construction of modern roads especially in the agricultural areas of the Jebel, because agriculture and pastoralism are still the two main natural resources of the Jebel people.

Appendix I

Mean Monthly and Annual Rainfall in MMS  
(Garian)

Table (1)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1924	?	4.9	24.5	0.0	15.3	1.7	9.1	0.0	0.0	10.2	8.6	61.1	(135.4)
1925	(144.7)	41.2	46.6	1.2	?	1.0	0.0	0.0	7.9	183.6	149.1	126.2	(701.5)
1926	175.8	132.5	65.1	56.8	0.4	15.2	0.0	0.0	10.4	0.1	9.4	44.3	510.0
1927	70.9	25.9	78.6	5.3	0.0	0.0	0.0	0.0	9.9	?	?	?	(190.6)
1928	146.0	103.2	34.7	8.4	1.4	0.0	0.0	0.0	3.7	3.2	26.3	130.0	456.9
1929	97.2	80.1	93.1	7.6	4.4	18.3	0.0	0.8	28.5	16.3	86.4	55.8	488.5
1930	28.8	43.5	33.8	24.0	11.6	0.0	0.0	0.0	0.0	35.3	35.8	43.6	256.4
1931	62.6	54.4	0.0	0.0	16.7	0.0	0.0	0.0	29.7	13.0	8.6	74.5	259.5
1932	183.3	33.6	61.0	0.0	0.0	0.0	0.0	0.0	18.2	57.8	91.1	57.9	502.9
1933	60.5	152.7	100.9	0.8	5.1	6.4	0.0	0.0	0.0	0.0	32.0	110.0	468.4
1934	164.9	71.6	19.3	1.1	44.8	0.0	0.0	0.0	11.9	52.0	31.2	45.7	442.5
1935	48.8	15.5	71.6	0.1	0.9	0.0	0.0	4.3	29.1	5.7	18.8	2.2	197.0
1936	49.2	3.2	3.1	40.4	14.3	0.0	0.0	0.0	0.0	9.0	28.2	109.5	256.9
1937	59.7	63.6	7.0	24.6	3.0	0.0	0.0	0.0	15.2	42.5	20.4	16.8	252.8
1938	133.4	80.3	100.9	49.2	21.7	0.2	0.0	3.3	0.2	8.3	69.2	81.2	547.9
1939	81.3	74.3	28.9	51.1	16.2	0.2	0.0	0.1	29.4	0.8	23.1	30.4	335.8
1940	15.0	0.5	14.9	10.5	2.2	0.0	0.0	3.0	64.2	18.8	4.5	?	(133.6)
1941	0.0	12.4	20.9	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	28.4	63.5
1942	28.5	7.7	22.1	0.0	0.0	4.0	0.0	0.0	0.0	(6.7)	17.0	?	(86.0)
1943	?	?	?	?	?	?	?	?	?	4.4	86.6	8.0	(99.0)
1944	148.8	31.4	46.7	65.0	0.0	0.0	0.0	0.0	11.7	4.9	76.6	22.8	407.9
1945	21.2	127.0	33.0	4.5	51.5	5.5	7.5	0.0	0.0	83.0	18.0	99.5	450.7
1946	86.0	79.0	17.9	16.6	4.0	0.0	0.0	0.0	23.5	4.5	14.0	22.2	267.7
1947	24.3	3.8	18.2	13.3	2.0	0.0	0.0	0.0	3.0	4.5	60.0	22.7	151.8
1948	27.8	6.0	19.8	11.0	6.4	0.0	0.0	0.0	6.0	20.4	105.7	32.3	235.4
1949	39.1	40.7	65.4	24.2	1.5	1.3	0.0	8.9	0.0	54.5	12.9	25.5	274.0
Aver.	74.6	49.6	40.4	15.8	8.7	2.2	0.6	0.8	12.1	23.8	39.4	53.1	322.6

Table (2) Rain Days per Annum in MMS  
(Garian)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1924	?	3	8	0	4	3	2	0	0	5	2	9	(36)
1925	(9)	5	9	3	?	1	0	0	1	7	7	5	47
1926	5	5	9	4	1	4	0	0	2	1	5	11	47
1927	8	6	7	3	0	0	0	0	(2)	2	?	?	(28)
1928	13	11	4	2	1	0	0	0	1	1	3	12	48
1929	8	15	11	5	2	2	0	2	4	4	5	13	71
1930	9	3	5	1	2	0	0	0	0	3	4	5	32
1931	6	7	0	0	4	0	0	0	6	4	3	8	38
1932	17	7	5	0	0	0	0	0	3	5	8	5	50
1933	5	7	8	1	3	4	0	0	0	0	9	9	46
1934	10	7	4	1	3	0	0	0	2	5	6	5	43
1935	8	1	10	1	2	0	0	1	1	3	4	1	32
1936	6	1	1	4	3	0	0	0	0	4	6	13	38
1937	7	7	1	4	2	0	0	0	3	5	7	11	47
1938	12	12	12	12	3	1	0	2	1	4	11	10	80
1939	6	4	9	5	3	1	0	1	5	1	5	5	45
1940	6	1	4	3	2	0	0	1	4	3	3	?	(27)
1941	0	4	4	0	2	0	0	0	0	0	0	6	16
1942	6	5	5	0	0	1	0	0	0	(5)	6	?	(28)
1943	?	?	?	?	?	?	?	?	?	2	7	2	(11)
1944	9	2	6	4	0	0	0	0	2	8	9	6	46
1945	5	14	7	2	6	1	1	0	0	10	6	6	58
1946	12	8	5	4	4	0	0	0	4	3	5	8	53
1947	6	3	1	5	1	0	0	0	3	5	8	5	37
1948	4	4	11	7	2	0	0	0	2	5	14	10	59
1949	15	7	10	2	1	1	0	2	0	9	3	9	59
Aver.	7.9	6.0	5.9	2.8	2.0	0.7	0.1	0.3	1.8	3.8	5.8	7.4	44.5

Mean Monthly and Annual Rainfall in MMS  
(Tigrinna)  
 Table (3)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1934	-	-	-	-	-	-	-	-	-	-	(24.2)	49.4	(73.6)
1935	55.8	7.5	49.0	?	?	?	?	?	?	?	?	?	(112.3)
1937	57.3	57.8	1.5	21.5	0.9	1.5	0.0	0.0	13.0	38.0	18.3	15.4	225.2
1938	133.3	79.3	100.9	49.2	17.2	0.0	0.0	3.3	0.2	8.3	70.1	81.2	543.0
1939	81.3	74.3	31.6	36.2	18.2	0.2	0.0	0.1	28.8	?	29.2	22.3	(322.2)
1940	14.5	0.0	15.0	13.5	5.0	0.0	0.0	3.4	102.7	9.8	5.1	41.8	210.8
1941	17.0	15.5	24.1	1.6	18.1	5.2	0.0	0.0	5.0	5.7	67.3	14.5	170.0
1942	40.5	11.0	28.5	?	?	?	?	?	?	?	?	?	(80.0)
1943	?	?	?	?	?	?	?	?	?	2.0	63.5	12.5	(78.0)
1944	192.0	49.5	73.0	60.0	0.0	0.0	0.0	0.0	17.6	1.2	104.5	33.6	531.4
1945	18.5	102.0	22.5	3.5	46.5	3.1	9.4	0.0	0.0	96.5	16.6	82.7	401.3
1946	77.7	69.0	11.8	10.7	0.9	0.0	0.0	0.0	15.8	2.2	8.0	16.0	212.1
1947	24.1	1.0	12.8	6.3	0.9	0.0	0.0	0.0	2.9	14.5	38.8	22.1	123.4
1948	42.3	1.7	13.3	8.8	3.5	0.0	0.0	0.0	4.3	1.8	82.2	31.9	189.8
1949	45.0	29.3	46.8	39.5	1.5	1.0	0.0	18.5	0.0	26.9	17.1	16.3	241.9
Aver.	61.5	38.3	33.1	22.8	10.2	1.0	0.9	2.3	17.3	18.8	43.4	33.8	283.4

Table (4) Rain Days per Annum in MMS  
(Tigrinna)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1934	-	-	-	-	-	-	-	-	-	-	(3)	5	(8)
1935	8	1	6	?	?	?	?	?	?	?	?	?	(15)
1937	7	7	1	3	2	1	0	0	3	5	7	7	43
1938	10	12	12	12	3	0	0	2	1	5	11	9	77
1939	6	4	9	2	3	1	0	1	4	?	6	4	(40)
1940	6	0	4	4	1	0	0	1	5	3	1	5	30
1941	1	3	2	1	3	2	0	0	2	2	6	4	26
1942	3	2	4	?	?	?	?	?	?	?	?	?	(9)
1943	?	?	?	?	?	?	?	?	?	1	5	5	(11)
1944	11	5	9	4	0	0	0	0	2	2	8	10	51
1945	6	13	8	2	6	1	1	0	0	7	9	8	61
1946	14	9	5	4	1	0	0	0	5	2	3	8	51
1947	5	1	1	3	1	0	0	0	1	6	6	3	27
1948	3	1	5	5	2	0	0	0	1	1	13	8	39
1949	11	4	9	2	1	1	0	1	0	5	2	4	40
Aver.	7.0	4.8	5.8	3.8	2.1	0.5	0.1	0.5	2.2	3.5	6.4	6.2	42.9

Mean Monthly and Annual Rainfall in MMS  
(Bu Mead)

Table (5)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1934	-	-	-	-	-	-	-	-	-	-	31.7	24.8	(56.5)
1935	30.0	1.2	50.8	0.0	0.0	0.0	0.0	0.0	4.5	0.8	13.6	4.0	104.9
1936	43.8	0.0	0.0	40.5	12.4	1.0	0.0	0.0	0.0	3.6	37.0	78.7	217.0
1937	64.6	83.0	2.0	19.5	0.0	0.0	0.0	0.0	37.0	14.5	20.5	9.5	250.6
1938	106.0	108.5	118.0	57.0	0.0	0.0	0.0	0.0	0.0	16.0	62.0	?	(467.5)
1940	?	?	?	13.5	3.0	0.0	0.0	5.5	6.5	9.5	8.0	55.5	(101.5)
1941	15.0	20.0	19.0	2.0	0.0	12.0	0.0	0.0	0.0	2.5	80.5	12.5	163.5
1942	46.5	11.5	26.0	0.0	0.0	0.0	0.0	0.0	3.5	24.5	15.0	63.5	190.5
1946	?	?	?	?	?	?	?	?	17.0	9.0	6.0	15.0	47.0
1947	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	7.0	39.0	32.0	118.0
1948	24.0	2.0	17.5	6.1	0.7	0.0	0.0	0.0	3.0	8.1	63.9	23.9	149.2
1949	39.3	51.6	22.7	19.8	4.4	0.0	0.0	8.8	0.0	2.4	6.8	15.7	171.5
Aver.	42.7	30.9	28.4	15.8	2.1	1.3	0.0	1.4	8.8	8.9	32.0	30.5	202.8

Table (6) Rain Days per Annum in MMS  
(Bu Mead)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1934	-	-	-	-	-	-	-	-	-	-	5	7	(12)
1935	7	2	5	0	0	0	0	0	2	1	2	1	20
1936	5	0	0	3	2	1	0	0	0	2	3	11	27
1937	7	4	1	2	0	0	0	0	2	2	4	4	26
1938	4	8	8	3	0	0	0	0	0	3	7	?	(33)
1940	?	?	?	2	1	0	0	1	1	2	3	7	(17)
1941	1	3	2	1	0	1	0	0	0	2	6	7	23
1942	6	3	4	0	0	0	0	0	2	3	2	8	28
1946	?	?	?	?	?	?	?	?	3	1	2	5	(11)
1947	3	0	0	0	0	0	0	0	1	2	7	2	15
1948	1	1	6	6	1	0	0	0	1	6	10	7	39
1949	13	5	7	3	2	0	0	2	0	3	2	8	45
Aver.	5.2	2.9	3.7	2.0	0.6	0.2	0.0	0.3	1.1	2.5	4.4	6.1	29.0

Table (7) Monthly and Annual Rainfall in MMS  
(Al Asabaa)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1941	-	-	-	-	-	-	-	-	-	-	108.0	0.5	(128,5)
1942	?	?	24.0	?	?	?	?	?	?	?	?	?	(24.0)
1943	?	?	?	?	?	?	?	?	?	3.0	35.0	6.0	(44.0)
1944	282.5	45.0	66.5	58.0	0.0	0.0	0.0	0.0	44.0	2.8	83.0	33.9	615.7
1945	17.4	106.3	18.5	2.0	48.5	4.0	8.0	0.0	0.0	71.0	28.4	92.2	396.3
1946	65.3	84.6	13.2	20.0	1.2	0.0	0.0	0.0	56.2	0.0	6.0	24.0	270.5
1947	23.0	0.0	8.0	5.7	0.0	0.0	0.0	0.0	12.2	13.5	39.7	22.3	124.4
1948	64.2	3.8	22.8	6.8	4.0	0.0	0.0	0.0	4.0	3.8	102.5	39.5	251.4
1949	77.3	54.5	39.5	26.5	1.0	0.0	0.0	10.0	0.0	26.0	12.5	21.3	268.6
Aver.	88.3	49.0	27.5	19.8	9.1	0.7	1.3	1.7	19.4	17.2	51.9	32.5	318.4

Table (8) Rain Days per Annum in MMS  
(Al Asabaa)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1941	-	-	-	-	-	-	-	-	-	-	4	4	(8)
1942	?	?	3	?	?	?	?	?	?	?	?	?	(3)
1943	?	?	?	?	?	?	?	?	?	1	4	5	(10)
1944	13	5	9	3	0	0	0	0	2	1	8	10	51
1945	4	13	6	1	5	1	1	0	0	5	8	7	51
1946	13	9	3	3	1	0	0	0	4	0	2	8	43
1947	4	0	1	3	0	0	0	0	1	6	6	3	24
1948	2	1	5	4	2	0	0	0	1	1	11	5	32
1949	10	5	5	3	1	0	0	3	0	2	2	6	37
Aver.	7.7	5.5	4.6	2.8	1.5	0.2	0.2	0.5	1.3	2.3	5.6	6.0	38.2

Appendix II

Table 1. Garian District Age structure by sex.

Age in years	Both sexes	Male	Female
All ages	56654	28809	27845
Under 1 year	1629	809	820
1 year	1281	628	653
2 years	2195	1055	1140
3 "	1179	954	925
4 "	1900	936	964
5 "	1805	844	961
6 "	1753	881	872
7 "	1334	676	658
8 "	1875	932	943
9 "	706	360	346
10-14 years	6130	3329	2801
15-19 "	4678	2589	2089
20-24 "	4561	2398	2163
25-29 "	4621	2337	2284
30-34 "	2537	1698	1839
35-39 "	2852	1507	1345
40-44 "	2247	1044	1203
45-49 "	1870	956	914
50-54 "	2330	1153	1177
55-59 "	1226	720	506
60-64 "	1930	1013	917
65-69 "	1200	593	407
over 70 "	2631	1387	1244

Table 2 Marital Status by Age and Sex.

	Under 15	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Males	11404	2589	2398	2337	1698	1507	1044	956	1155	720	1013	593	1307
Singles	11398	2479	1860	824	181	61	20	12	16	9	8	3	17
Married	5	48	453	1385	1419	1366	976	901	1667	662	904	513	1080
1 wife	5	48	450	1379	1391	1322	940	854	1008	619	856	494	1044
2 wives	-	-	3	6	27	46	35	47	58	40	47	19	33
3 "	-	-	-	-	1	1	1	-	1	3	1	-	3
4 "	-	-	-	-	-	-	-	-	-	-	-	-	-
Widowed	1	1	12	20	27	27	15	27	35	26	66	50	247
Divorced	-	2	35	82	60	50	31	14	31	19	30	25	36
Unknown	-	59	38	26	11	1	2	2	9	4	5	2	7
Females	10973	2089	2163	2284	1839	1345	1263	914	1777	506	917	407	1244
Single	10968	1516	338	79	33	6	8	3	6	2	14	6	12
Married	5	495	1682	2073	1687	1244	1101	780	876	351	443	194	229
Widowed	-	3	16	34	52	58	104	107	243	128	410	186	925
Divorced	-	46	117	94	61	31	38	18	46	20	37	17	46
Unknown	-	29	10	4	6	6	7	6	-	5	13	4	32

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## ABSTRACT

The Jebel Garian is a small section of the Tripolitânian escarpment, and lies between the Jebels Yefren to the west and Tarhuna to the east. Its geological formations are composed of volcanic rocks, Triassic, Jurassic and Cretaceous deposits. This region has a climatic régime, intermediate to the Mediterranean and Saharan climates. The surface of the Jebel varies from major plateaux and deep wadis to isolated volcanic summits at the foot of the Jebel. Erosion has dissected the plateaux and gorged the wadis. Underground water resources are limited to the bottom of the wadis. Soil potentiality is high compared with other regions of Tripolitania. The vegetation cover is restricted to the more humid zone of the Jebel which enjoys greater rainfall. Afforestation is concentrated in Bu Gheilan.

The Jebel Garian has a population of 34,132, or 4.6%, of the total population of Tripolitania. The people are mostly Berbers and Arabs with a limited number of Arabised Berbers and Italians. The settlement patterns vary from ancient villages, underground troglodyte dwellings and Bedouin tents to modern Italian houses in both Trigrinna Estate and Garian Town. The basis of the Jebel economy is agriculture, and the success of crops depends on the reliability of the rainfall, since most of the Berber farmers use dry-farming methods. Irrigation of vegetables exists only in restricted areas and modern techniques are confined to the ex-Italian farms. Livestock farming is also important especially in the south, and depends on the

existence of grazing land and permanent water resources, but local industry is still primitive since it relies on agricultural products. Modern communications are virtually restricted to the one main road of good quality. Finally, a lack of education and of a knowledge of the principles of hygiene have contributed to the low standard of living prevalent among the Jebel population.

Plate 1A



Effect of run-off on the slopes of the escarpment,  
(North-west of Garian town)

Plate 1B



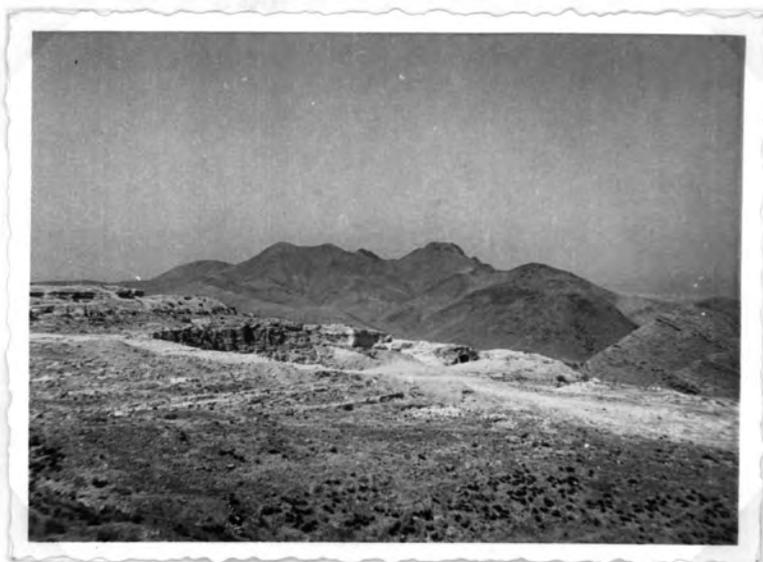
Another aspect of the effect of run-off on Bu  
Gheilan limestones.

Plate 2.



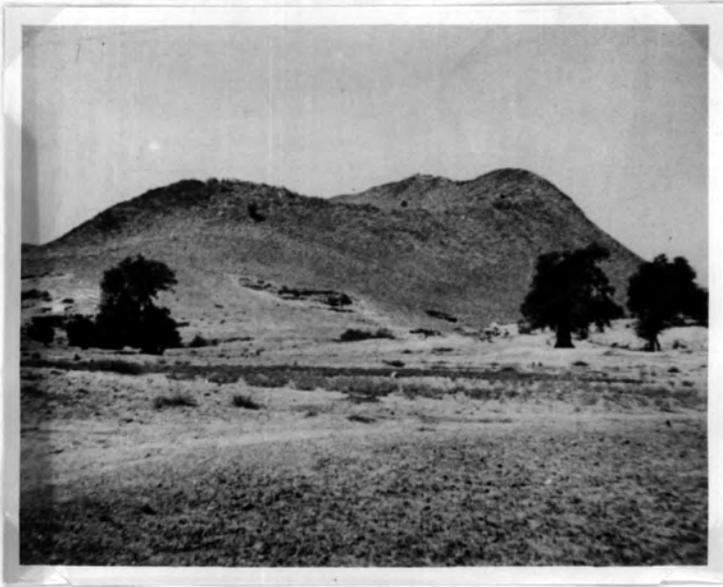
Wadi el Hamman.

Plate 3



Bu Gannush.

Plate 4



Caf Tecut.

Plate 5



Bu Gheilan.

Plate 6



A typical gully in Guasem plateau.

Plate 7



Major springs in the bottom of Wadi Tegassat,  
(West of Garian town).

Plate 8



Bu Gheilan's spring at the foot  
of the escarpment.

Plate 9



Pistacia Atlantica, Wadi el Hamman.

Plate 10A

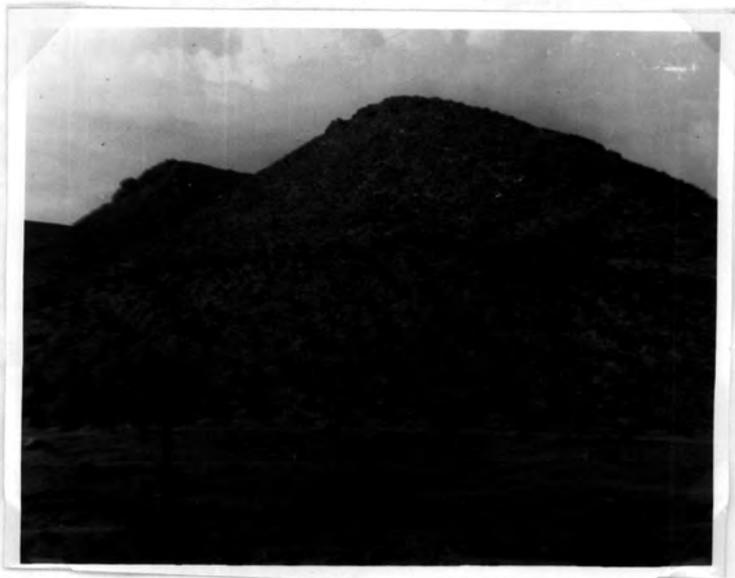


Stipa tenacissima, Al Orban.

Plate 10B



Stipa tenacissima, Al Asabaa



Afforested slope at Bu Gheilan.



Ancient Berber village, Cleba.

Plate 12B



Ancient Berber village, Usaden.

Plate 12C



Ancient Berber village, Slahat.

Plate 13



A castle "Gasr", Cleba.

Plate 14



Small Berber village, Mgarba.

Plate 15



A typical ancient village at the slope of  
Wadi Torshin, Bu Ayyad.

Plate 16



Primitive troglodyte dwellings, Slahat.

Plate 17



Advanced troglodyte dwellings, Dannun.

Plate 18



Modern Italian village, Trigrinna.

Plate 19



Azienda Tabacchi Italiani, Trigrinna.

Plate 20



Ex-Italian farmhouse, Trigrinna.

Plate 21A



Market place, Al-Asabaa.

Plate 21B



Type of settlement patterns  
during winter, Al-Asabaa.

Plate 22



Market place, Al Orban.

Plate 23



Modern Garian town.

Plate 24

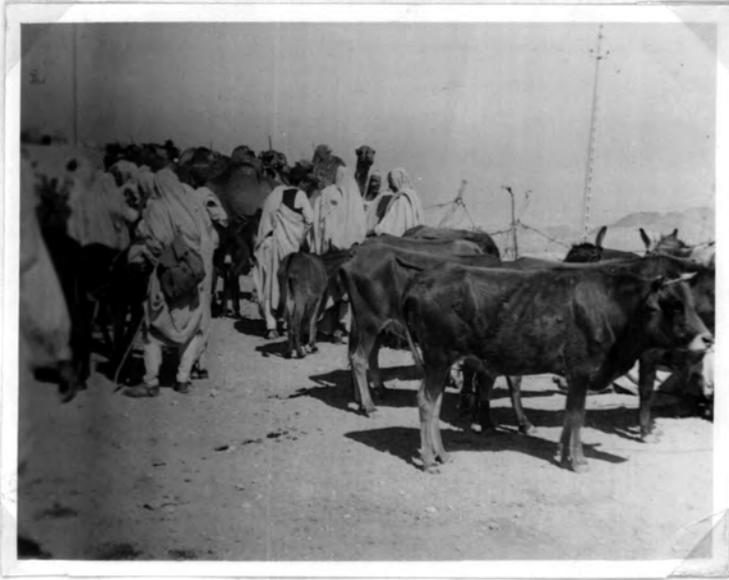


Main street of Garian on market day.

Plate 25A



Market place of Garian town.

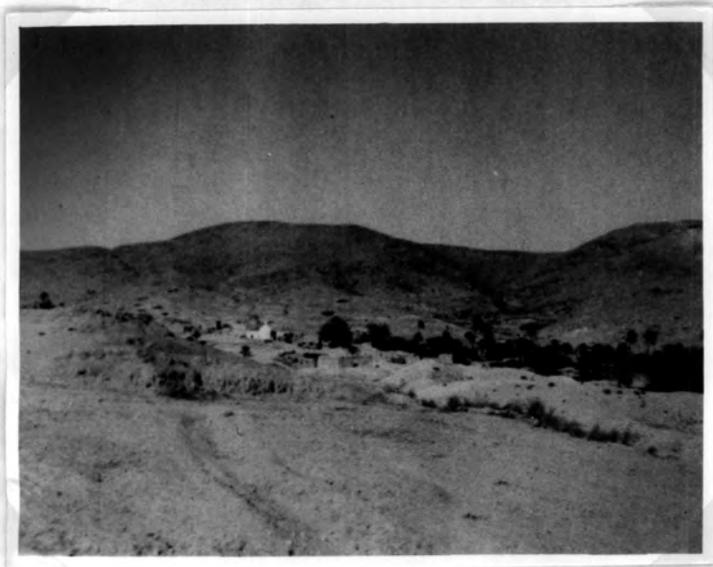


Livestock at the market place.



The Jebel Hotel, Garian.

Plate 27



Irrigated gardens at Kmashat.

Plate 28



Dry cultivated gardens at Al Guasem.

Plate 29



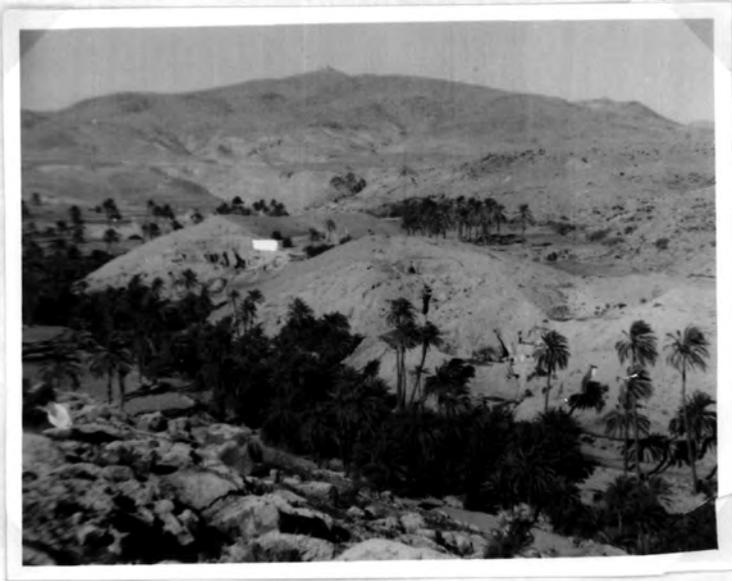
Irrigated gardens at Wadi Nakhle, Al Guasem.

Plate 30



Cultivated terraces at the Wadi Tegassat.

Plate 31



Major cultivated belt at the bed of Wadi Gan.

Plate 32



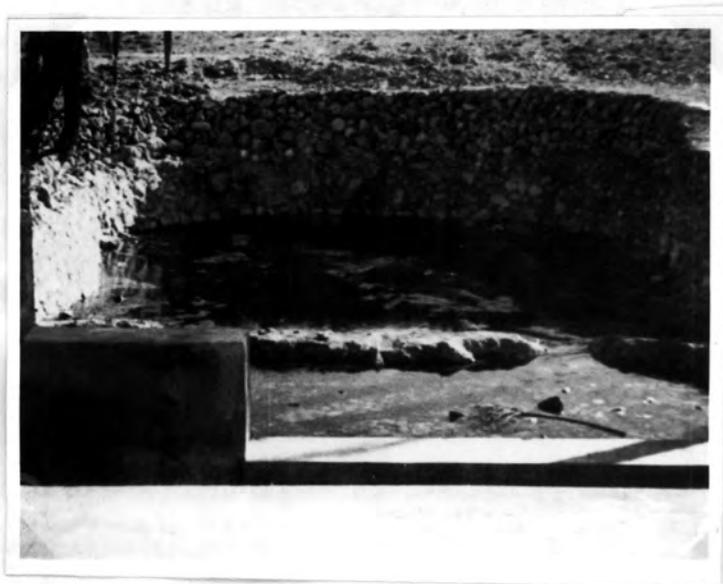
Dry cultivated gardens at Wadi Njasat.

Plate 33A



Irrigated gardens at Rabta al Garbia.

Plate 33B



Rabta al Garbia's spring.

Plate 34



Rabta al Shargia's spring and the irrigated gardens.

Plate 35



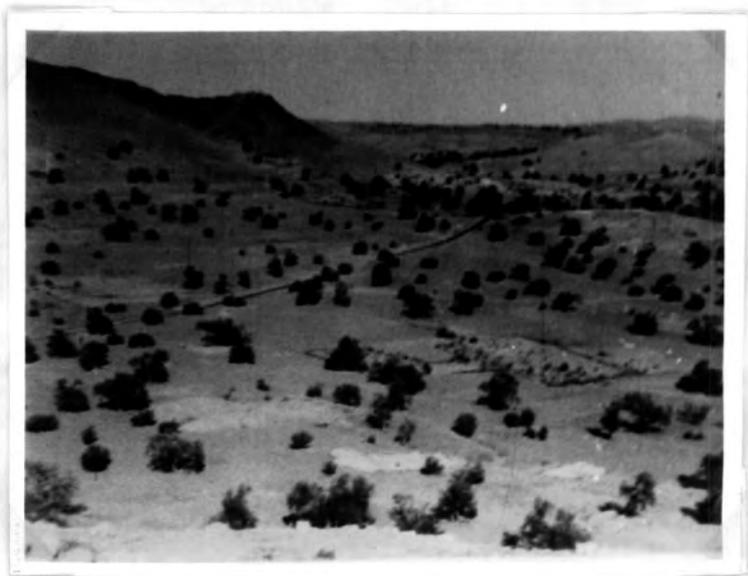
Major spring of Bu Gheilan.

Plate 36A



Jebel olive tree, at Guasem.

Plate 36B



Berber olive trees, Al Guasem.

Plate 37



Italian olive trees, Trigrinna.

Plate 38



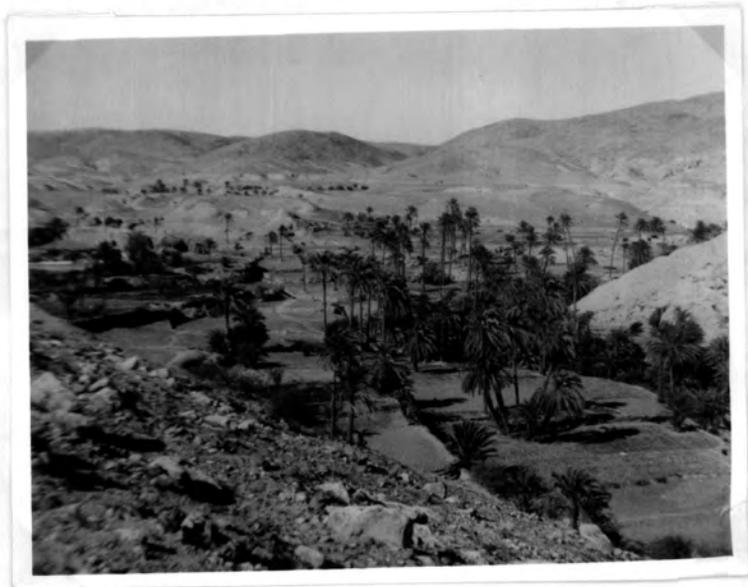
Fig trees, al Asabaa.

Plate 39



Date palms, Wadi Torshin.

Plate 40



Date palms, Salehat.

Plate 41A



Harvesting of esparto, Al Orban.

Plate 41B



Transportation of esparto from Al Orban to Tripoli.

Plate 42



Grazing of livestock, Ghibla.

Plate 43



Camel is the only important animal for ploughing.

Plate 44



Modern olive press and flour-miller, Tigrinna.

Plate 45



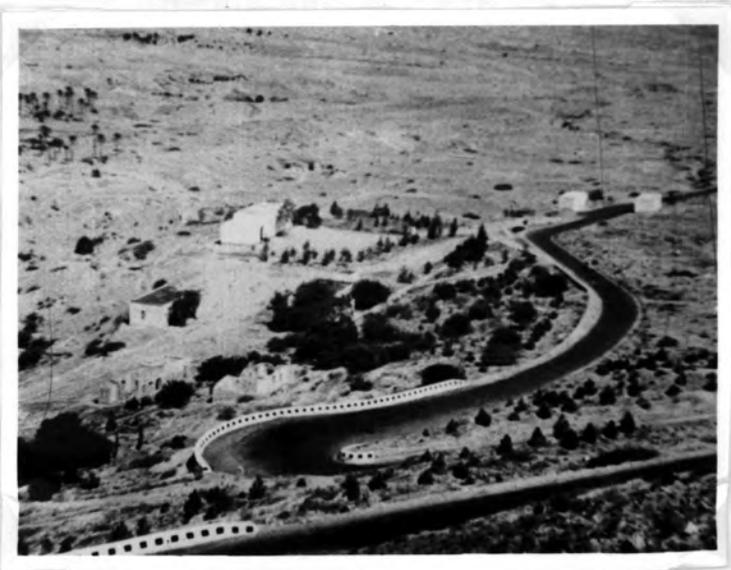
Pottery, workshop, Miamin.

Plate 46



Pots are ready for exportation, Miamin.

Plate 47A



Main road at Bu Gheilan.

Plate 47B



Main road at Al Guasem.

Plate 48



Secondary road, Tigrinna.

Plate 49



A typical Jebel track between  
Bu Zeyyan and Gattis.