Morphometry of Desert Wadi Drainage on the West Bank between Danfiq and Ballas, Luxor-Qena Region, Egypt.

by

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ABSTRACT

Quantitative measurements of lineation and morphometric analyses of 24 wadi drainage basins on the west bank of the Nile between Danfiq and Ballas, Luxor-Qena region, reveal that (1) the drainage lines are mainly perpendicular to the course of the Nile and some variations in azimuth directions reflect adjustments to changes in the course of the Nile, (2) the relationship of stream length and stream numbers to stream order follows Horton's law, (3) the bifurcation ratio is 3.82 and compares favourably with values of 3.8 and 3.78 from drainage basins east of Cairo, (4) the relationship between stream length (L) and stream area (A) is $L = 3.87A^{0.76}$ suggesting that basins tend to become elongated as they grow in area, (5) the average density is 1.85 ± 0.72 and compares favourably with low drainage density from other wash basins in Egypt; it is likely that the wadis were developed under an arid climate, (6) structural control was detected as a factor responsible for intra-regional differences in drainage density and stream frequency, and (7) the relative frequency data suggest that the drainage systems have reached a stage of steady state equilibrium.

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Introduction

The green strip of the Nile Valley on the west bank between Luxor and Qena is bordered by a low desert of Quaternary terraces which range in elevation from a few meters to 70 meters above the floodplain. The terraces overlie an older Pliocene fill that rises to about 140 meters above the floodplain. The Quaternary and Pliocene deposits lap up against the cliffs of the Thebaid plateau, which is made in the most part of Lower Eocene Thebes Formation (see geological map Fig. 1).

One of the significant features of the low desert bordering the Nile floodplain are numerous waterless stream beds which run from the Thebaid plateau toward the Nile Valley. These dry water courses or wadis are located in a parched desert that receives between 1-4 mm of rain per year (Kassas 1955). Rain usually falls once every 10 or 12 years, sometimes in catastrophic flash floods (seil). In 1979, the wadis swelled with water and incurred serious damage to some settlements located at the mouth of the wadis.

The area chosen for morphometric analysis lies between Danfiq and Ballas (Fig. 2.). The networks for 24 drainage basins were traced from aerial photographs (1:40,000 scale). The major wadis identified by names on the Luxor and Qena sheets (1:100,000 of the Survey Department of Egypt) from north to south are :

Wadi Khor en-Na'im	Basin 2
Wadi Abdallah	Basin 6
Wadi Abd en-Naser	Basin 8
Wadi Hirfan	Basin 12
Wadi Maqar	Basin 17
Wadi Arqub el-Baghla	Basin 20
Wadi al-Himdaniyia	Basin 23

Horton's (1945) method of ordering streams was followed. Although the methods suggested by Strahler (1964) and Shreve (1966) could have been adopted, we preferred to apply Horton's method in order to correlate our results with those undertaken in other places of Egypt (Said and Beheiri 1961; Abdallah et al. 1977, Beheiri 1967) and elsewhere (e.g., Hack 1957). Lineation analysis was also attempted using 1:100,000 topographic maps.

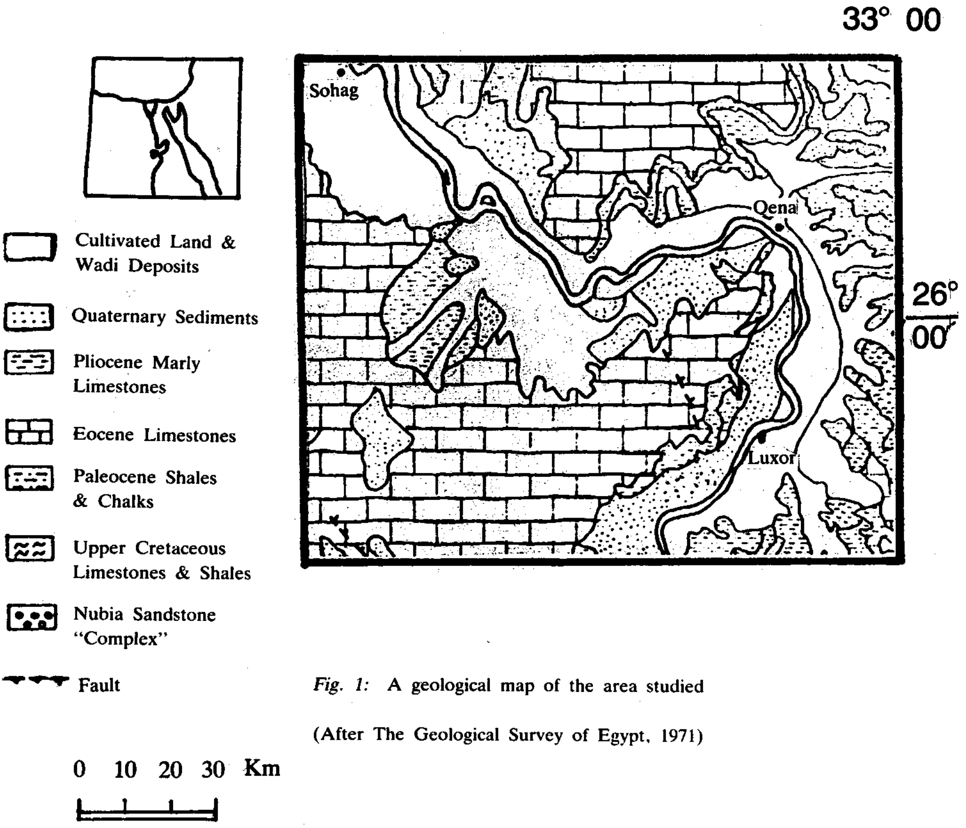

Fig. 1: A geological map of the area studied

(After The Geological Survey of Egypt, 1971)

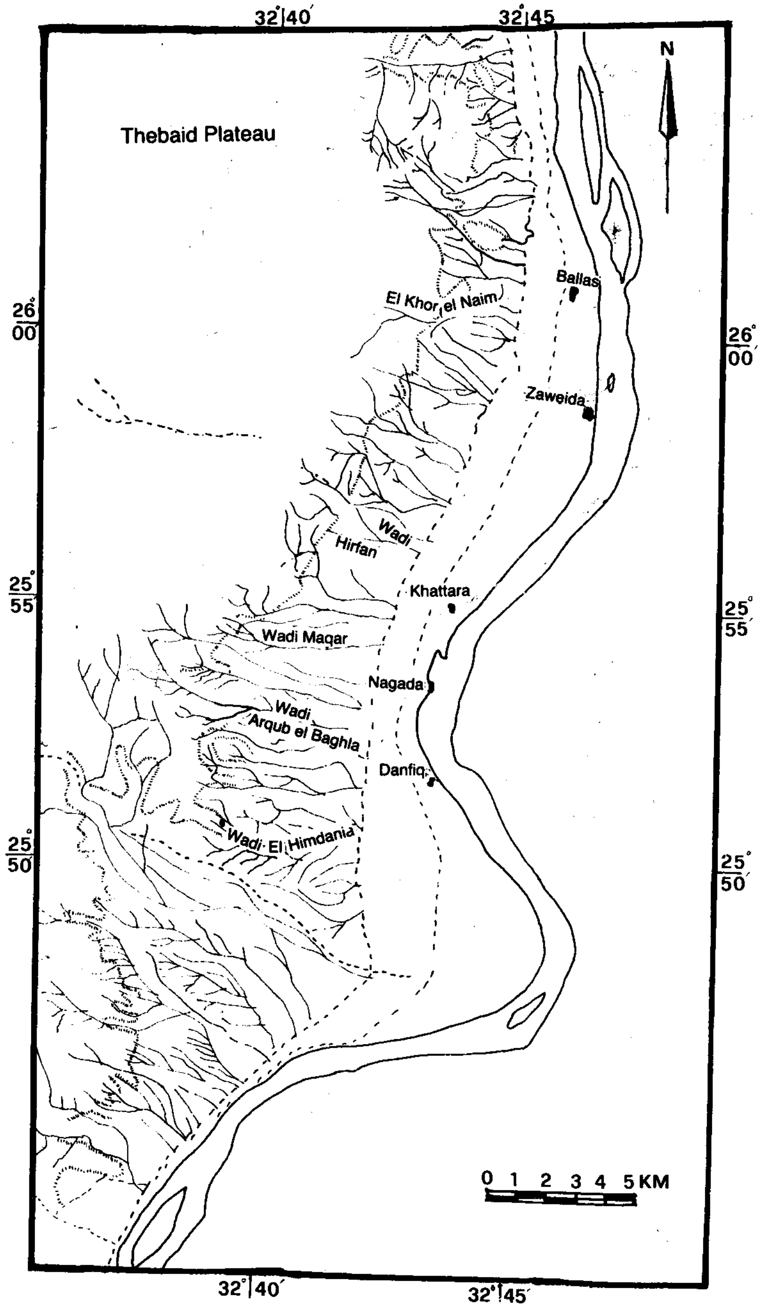

Fig. 2. Drainage map of Nagada region

The drainage patterrn is dendritic to parallel which is most likely a result of the horizontal bedding of the Thebes limestones and the younger sediments and the moderate slope of the region.

Lineation Analysis

The significance of lineation analysis for interpreting natural linear features in terms of lithologic, structural, or topography has been discussed by Cloos (1946), Brock (1956), Haman (1964), Norman (1969), and the application of Lineation analysis in Egypt was attempted by El-Etr (1967, 1971), Yehia (1970), Ghobrial (1971), and El-Etr et al. (1972a), and Abdallah et al. (1978).

The area under study was subdivided into 5 zones of approximately equal size (10-12 km^2). These grid units were labelled D_1, D_2, D_3, D_4, D_5 from North to South. The azimuth frequency of the drainage lines was calculated (Table 1) and plotted on Fig. 3.

The preferred orientation of the grid units is as follows —

D_1		N 10-20°W	N 40-70°W	N 70-80°W
D_2			N 50-60°W	
D_3	N70—80° E		N 60-70°W	
D_4	N70-90° E		N 60-70°W	
D_5	N60-70° E	N 40-50°W		N 80-90°W

These azimuth directions indicate that the drainage lines are mainly perpendicular to the course of the Nile River. The slight variations in azimuth directions track the meanders of the Nile. It is interesting to note that the deviation from this pattern which is illustrated by D_5. This anomaly is a result of the recent formation of the Danfiq meander from the accretionary growth of a point bar which is well reflected in the difference in the settlement pattern and nomenclature of villages situated on the old floodplain and the more recent segment of the floodplain. The subsidiary dominant azimuth directions may thus reflect changes in the course of the Nile and which served as the base level for the alluvial processes in the wadis. The formation of the wadi network thus seems to be connected with the establishment of the Nile System.

Table 1

Lineation Analysis of the Drainage Lines in El-Zaweida, Danfiq Region.

	D_1				D_2				D_3				D_4				D_5			
N — W	*N*	*N%*	*L*	*L%*	*N*	*N%*	*L*	*L%*	*N*	*N%*	*L*	*L%*	*N*	*N%*	*L*	*L%*	*N*	*N%*	*L*	*L%*
0 — 10	2	5.0	0.8	3.2	2	5.9	1.15	5.6	—	—	—	—	—	—	—	—	—	—	—	—
10 — 20	5	12.5	2.1	8.5	2	5.9	0.65	3.1	—	—	—	—	—	—	—	—	2	5.9	0.4	1.7
20 — 30	1	2.5	0.3	1.2	2	5.9	1.45	7.0	1	4	0.7	4.2	—	—	—	—	—	—	—	—
30 — 40	3	7.5	1.9	7.7	3	8.8	1.8	8.7	2	8	1.5	9.1	4	12.5	3.1	11.8	2	5.9	0.8	3.4
40 — 50	6	15.0	4.85	19.6	3	8.8	1.6	7.7	1	4	2.3	13.9	—	—	—	—	4	11.8	1.9	8.0
50 — 60	5	12.5	2.95	11.9	5	14.7	3.2	15.5	1	4	0.35	2.1	1	3.1	0.45	1.7	1	2.9	0.8	3.5
60 — 70	7	17.5	5.4	21.8	2	5.9	2.75	13.3	5	20	3.25	19.7	6	18.8	5.0	19.0	3	8.8	3.5	14.6
70 — 80	3	7.5	2.05	8.3	9	26.5	4.6	22.2	3	12	2.1	12.7	3	9.4	2.95	11.2	4	11.8	4.5	18.8
80 — 90	4	10.0	2.8	11.3	1	2.9	0.5	2.4	4	16	1.8	10.9	4	12.5	4.9	18.6	6	17.7	6.4	26.8
N — E 0 — 10	1	2.5	0.2	0.8	1	2.9	0.7	3.4	1	4	0.4	2.4	—	—	—	—	2	5.9	0.4	1.7
10 — 20	—	—	—	—	—	—	—	—	1	4	0.15	0.91	—	—	—	—	—	—	—	—
20 — 30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
30 — 40	—	—	—	—	—	—	—	—	—	—	—	—	1	3.1	0.4	1.5	1	2.9	0.3	1.3
40 — 50	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2.9	0.2	0.8
50 — 60	—	—	—	—	—	—	—	—	—	—	—	—	1	3.1	0.3	1.1	—	—	—	—
60 — 70	1	2.5	0.6	2.4	—	—	—	—	—	—	—	—	1	3.1	0.3	1.1	5	14.7	3.0	12.6
70 — 80	—	—	—	—	2	5.9	1.0	4.8	4	16	2.4	14.6	5	15.6	4.3	16.4	1	2.9	0.7	2.9
80 — 90	2	5	0.8	3.2	2	5.9	1.3	6.3	2	8	1.55	9.4	6	18.8	4.6	17.5	2	5.9	1.0	4.2
Total No. of drainage segments	40				34				25				32				34			
Total Length of Drainage	25.75 Km				20.7 Km				16.5 Km				26.3 Km				23.9 Km			
The area	11.52 Km^2				11.48 Km^2				10.77 Km^2				12.56 Km^2				10.19 Km^2			

(N, number of drainage lines; N%, percent of number of drainage lines; L, length of drainage line; L%, length percent of drainage line).

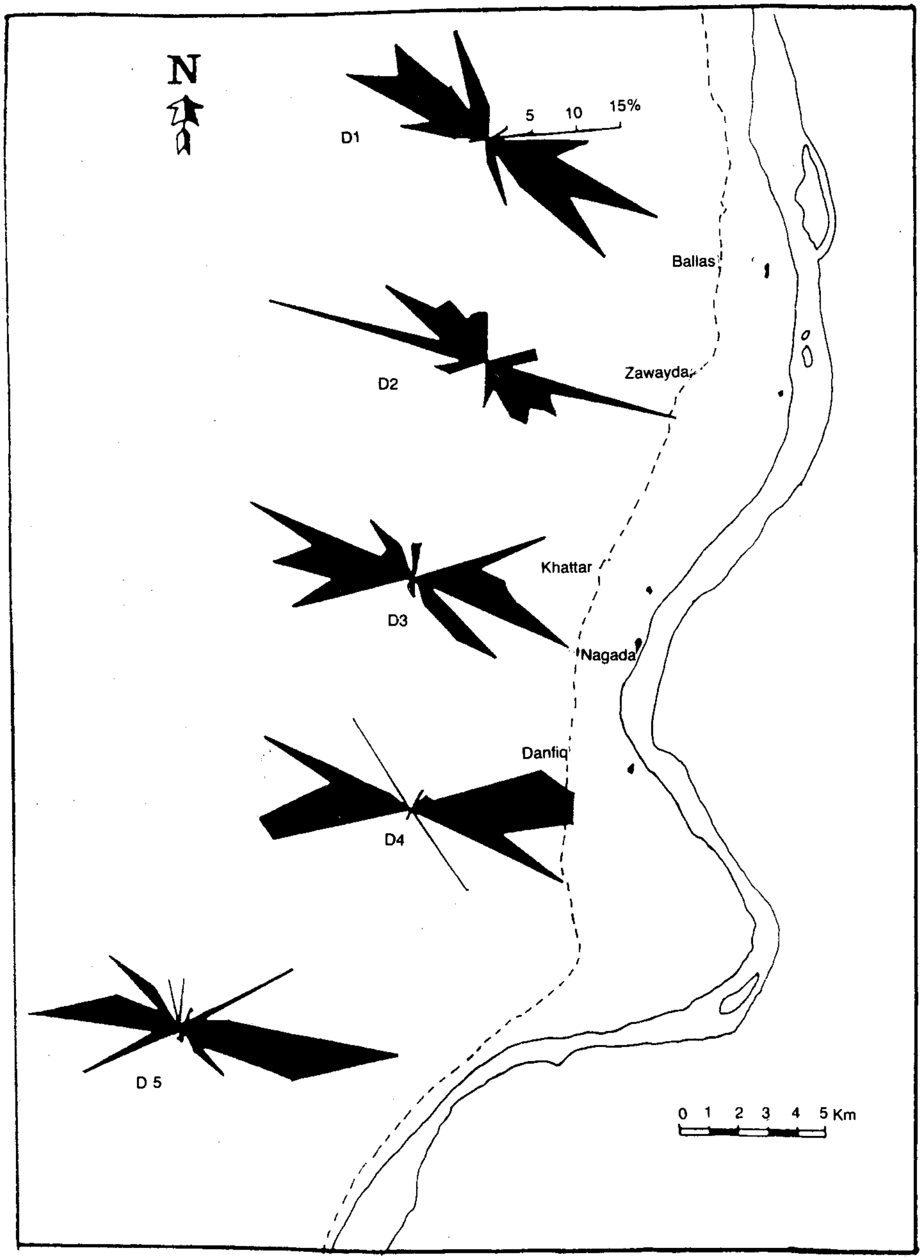

Fig. 3 Azimuth frequency diagrams of the drainage lineations in the studied area

Linear Basin Morphometry

One of the major contributions by Horton (1945) to the study of drainage networks is his recognition of nomothetic relationships of stream length and stream numbers to stream order. Stream order in Horton's method refers to the spatial position of a stream in a hierarchy of spatial order of tributaries. First-order streams have no tributaries. Second order streams are streams that have first order tributaries. In the Nagada regions most of the basins consist of a Third to Fifth-order stream (Fig. 4). When the number of streams (N) in each order is determined and plotted against stream order (O), on a semilog paper, a simple geometrical relationship is often revealed by a straight line. A similar relationship is also obtained when the average length of streams in each order is plotted on semilog paper against stream order. The geometrical relationship seems to result from an increase in the number of streams from one order to that of the next higher order by a constant ratio, called by Horton the "bifurcation ratio" (R_b). The value of this ratio in many samples from the United States is approximately 3.5 (Leopold et al., 1964) and shows a range from 2—4 (ibid.) or 3—5 (Chorley, 1971). The bifurcation ratio for arroyos in an area near Santa Fe, New Mexico (annual rainfall about 330 mm) is 3.5 (ibid.)

Table 2

Data sheet of drainage basin analysis based on aerial photographs, scale 1:40,000.

Basin No.	*Stream order*					*Stream mean length*					*Area Km²*	*Total length km*	*Density (D)*	*1/D*	*D²*	*Stream Frequency (F)*	*Relative Density F/D²*	*Weighted mean bifurcation*
	1st	*2nd*	*3rd*	*4th*	*5th*	*1st*	*2nd*	*3rd*	*4th*	*5th*								
1	6	2	1			0.63	1.76	3.4			8.412	10.68	1.27	0.79	1.61	1.06	0.66	2.73
2	12	3	1			0.51	0.97	5.68			13.48	14.76	1.10	0.91	1.21	1.19	0.98	3.79
3	4	1	1			0.91	1.04	1.60			3.80	6.28	1.65	0.61	2.7	1.82	0.67	3.14
4	7	3	1	1		0.42	1.44	3.68	3.80		10.92	14.72	1.35	0.74	1.82	1.10	0.60	2.39
5	4	1				0.77	2.84				5.55	5.92	1.07	0.94	1.14	0.90	0.79	4.00
6	7	3	1			0.57	1.95	4.16			13.91	14.00	1.01	0.99	1.02	0.79	0.78	2.52
7	9	2	1			0.30	0.66	2.96			4.34	7.00	1.61	0.62	2.59	2.77	1.07	3.96
8	19	6	2	1		0.30	0.27	0.94	4.68		7.82	13.88	1.78	0.56	3.17	3.58	1.13	3.04
9	15	8	2	1		0.23	0.32	0.78	1.64		2.38	9.20	3.86	0.26	14.9	10.91	0.73	2.49
10	39	14	3	1		0.22	0.48	1.51	1.52		8.62	21.24	2.46	0.41	6.05	6.61	1.09	3.23
11	8	1	1			0.17	0.96	1.20			1.12	3.52	3.15	0.32	9.92	8.96	0.90	6.72
12	34	8	2	1		0.19	0.50	0.62	2.96		13.53	20.38	1.5	0.67	2.25	3.32	1.48	4.08
13	28	7	2	1		0.24	0.48	2.28	3.88		8.92	18.4	2.06	0.49	4.24	4.26	1.01	3.78
14	8	3	1			0.17	0.61	1.92			1.79	5.12	2.85	0.35	8.12	6.68	0.82	2.76
15	38	14	1	1		0.21	0.53	2.56	4.32		7.68	22.36	2.91	0.34	8.47	7.03	0.83	5.11
16	82	25	3	1	1	0.25	0.66	2.68	5.12	6.52	28.85	56.92	1.97	0.51	3.88	3.88	1.00	4.24
17	18	5	1			0.54	1.71	6.84			15.15	25.12	1.66	0.60	2.76	1.58	0.57	3.89

Table 2 (Contd.)

Data sheet of drainage basin analysis based on aerial photographs, scale 2:40'000. Continued

Basin No.	*Steam order*					*Stream mean length*					*Area Km^2*	*Total length km*	*Density (D)*	$\frac{1}{D}$	D^2	*Stream Frequency (F)*	*Relative Density F/D^2*	*Weighted mean bifurcation*
	1st	*2nd*	*3rd*	*4th*	*5th*	*1st*	*2nd*	*3rd*	*4th*	*5th*								
18	6	2	1			0.37	1.20	5.24			5.24	9.88	1.89	0.53	3.59	1.72	0.48	2.73
19	5	1	1			0.43	0.96	4.76			4.53	7.88	1.74	0.57	3.03	1.54	0.51	4.00
20	5	13	3	1	1	0.51	0.95	3.07	9.08	9.64	39.50	66.16	1.68	0.60	2.82	1.74	0.62	3.89
21	24	4	1	1		0.53	1.77	4.68	9.48		22.35	33.88	1.52	0.66	2.31	1.34	0.58	5.43
22	10	2	1			0.54	1.84	5.52			13.96	14.60	1.05	0.95	1.10	0.93	0.85	4.40
23	32	12	3	1		0.65	1.40	3.63	6.76		41.01	55.32	1.35	0.74	1.82	1.17	0.64	3.01
24	18	5	1	1		0.37	1.45	0.88	6.56		11.63	21.36	1.84	0.54	3.39	2.15	0.63	3.70

The results from the Luxor-Qena area are in general agreement with "Horton laws" (Figs. 5 and 6). Small basins with a few streams (less than 10) were not plotted because of the greater probability of sampling error. These include basins Nos. 3, 5, 9 (quantitative analysis of individual basins is given in Table 2). Another modification in presenting the relationship between stream order and stream numbers was made to standardize the data and allow for comparison of basins from different regions (Fig. 7). In this modified method, the cumulative percent of stream numbers is plotted against stream order. The First order streams are standardized at 100. The following example shows the calculation of the cumulative percent for basin No. 16 (Table 3).

Table 3
Calculation of the Cumulative Frequency Percent of Number of Streams

Stream Order	No. of Streams	Cumulative No. of Streams	Cumulative Frequency Percent of Number of Streams
1st	82	113	100.0
2nd	25	31	27.40
3rd	3	6	5.30
4th	1	2	1.77
5th	1	1	0.89

The average weighted mean bifurcation ratio of the 24 basins is 3.70, a close figure to the 3.5 for many streams in the U.S. and the arroyos of New Mexico mentioned above. The range is from 2.39 to 6.72, but both of the extreme cases are from small basins with a few streams (10—12 streams). Excluding small basins, the average weighted mean bifurcation ratio is 3.82 ± 0.84. These values compare well also with estimates of bifurcation ratios for wadis east of Cairo by Said and Beheiri (1961) and at Wadi Degla, Maadi, near Cairo (Abdallah et al. 1977) Table 4.

Table 4

Bifurcation ratio for drainage basins in Wadi Degala, East Cairo, and Danfiq-Balls region.

Bifurcation Ratio	*Drainage Basin*	*Source*
3.82	24 basins, West Bank, Danfiq-Ballas region	This work
3.80	9 basins, East Cairo	Said & Beheiri (1961)
3.78	Wadi Degla	Abdallah *et al* (1977)

* (Wadi Degla and Wadi El Tih were combined since they form one drainage basins for the computation of this ratio from the data provided by Abdallah et al. 1977.

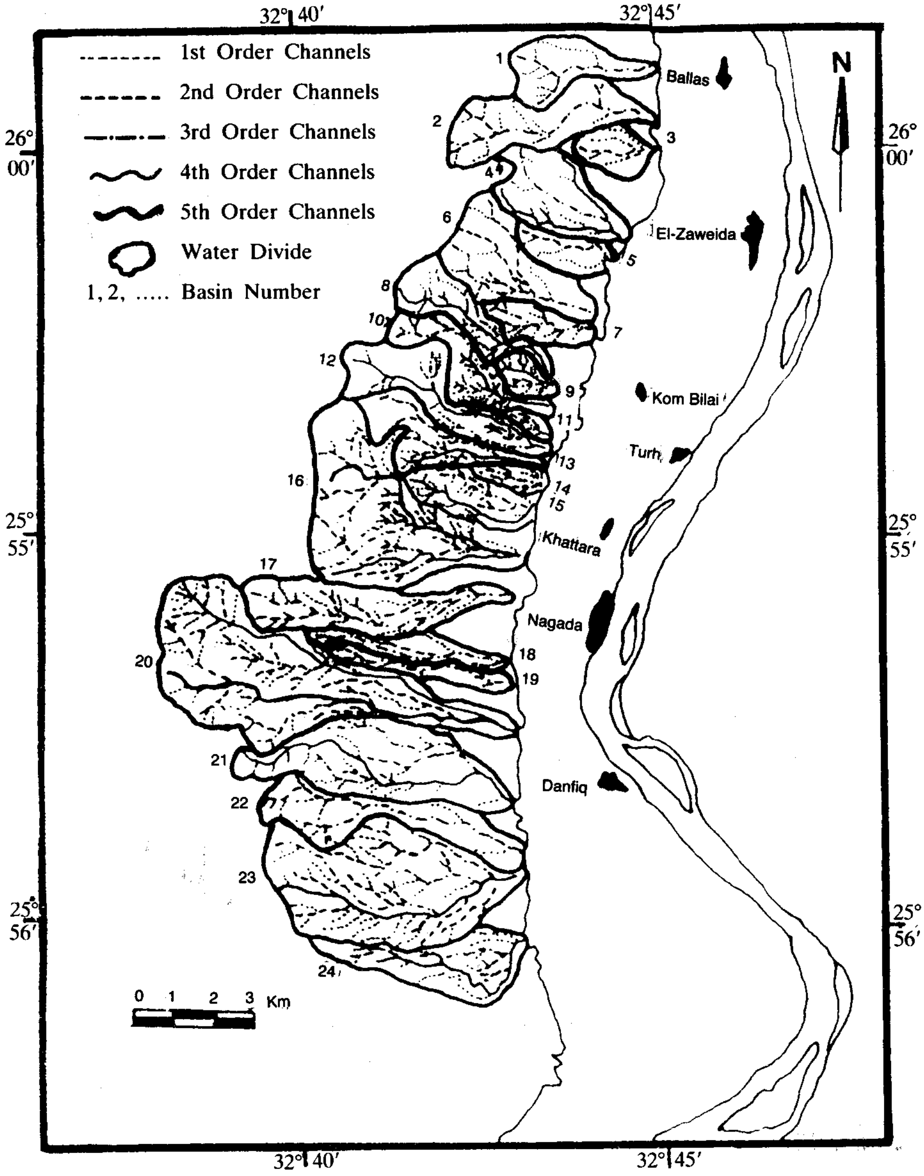

Fig. 4. Drainage basin analysis map.

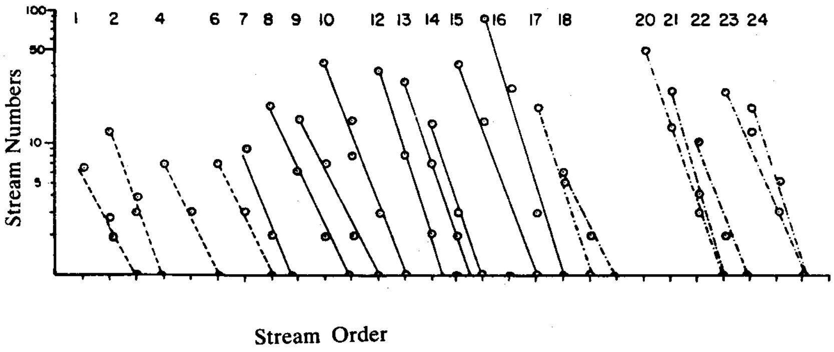

Fig. 5. Relationship between stream order and stream number.

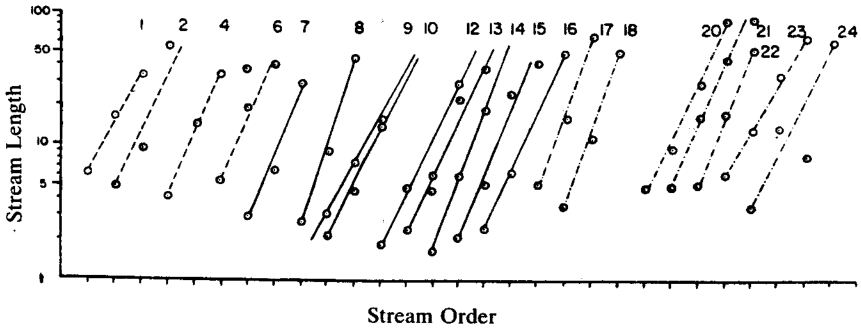

Fig. 6. Relationship between stream order and stream average length.

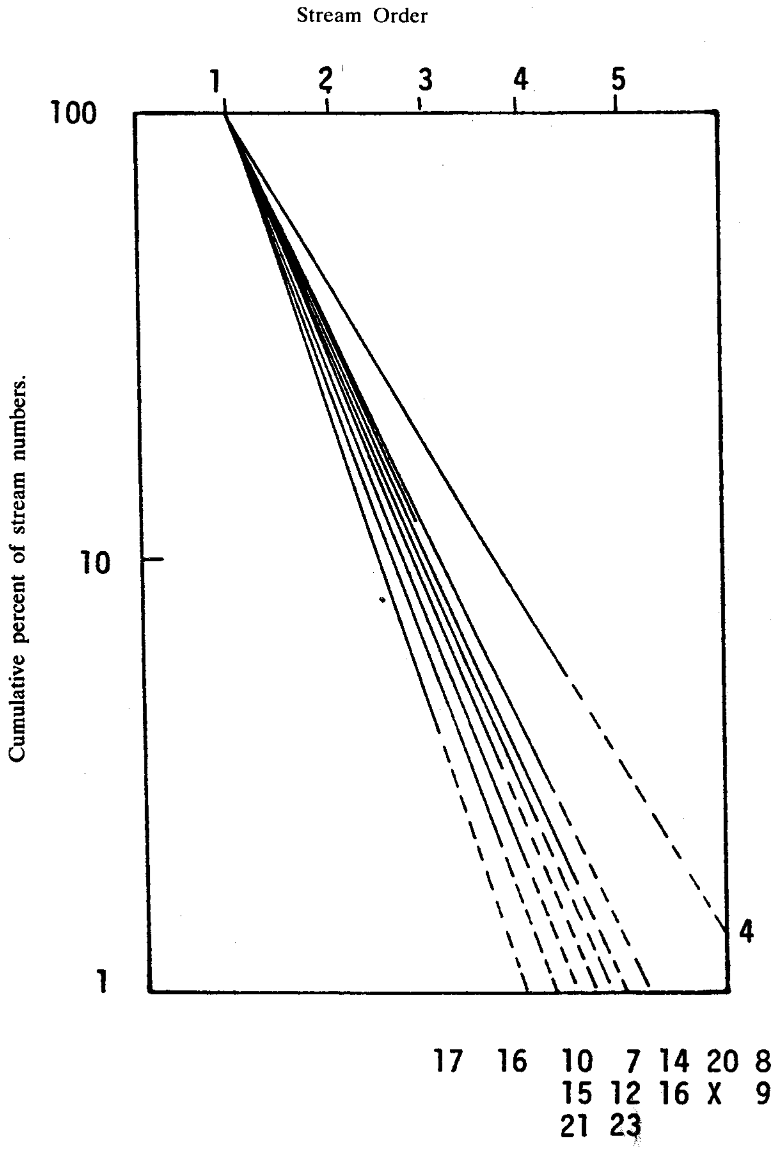

Fig. 7: Relation Between Stream Order to Cumulative Percent of Stream Numbers.

The available morphometric studies of drainage basins thus suggest a bifurcation ratio of 3.8, slightly higher than that for the streams of the U.S.

Areal Basin Morphometry

The drainage basins in the region under investigation are small in area. They average 12.27 km^2 (4.67 mi^2) (Table 2).

However, the range is wide 1.116 km^2 to 41.008 km^2, with a standard deviation of 10.76 km^2. The histogram of the basin area (Fig. 8) shows clearly that the majority of the basins actually fall between 1—15 km^2, with a mode of 5—10 km^2. The distribution of basin areas appears to reflect two normal populations (with Gaussian distribution) as shown by the plot of cumulative percent frequency of basin areas on a normal probability paper against basin area (Fig. 9).

The relationship between basin area and stream length was investigated. Hack (1957) in a similar investigation has shown that many streams follow the following relationship :

$$L = 1.4A^{0.6}$$

where L is the channel length in miles and A is the drainage area in square miles. In the northeastern U.S. the coefficient ranges from 1 to 2.5, with an average of 1.4 (Leopold et al., 1964). The coefficient provides an estimate of the area of the drainage basin that is sufficient on the average to maintain a certain channel length. Thus on the average, a drainage basin of 1 mi^2 will contain a channel 1.4 miles long. In the area under investigation the relationship follows the following equation :

$$L = 3.87A^{0.76}$$

where L and A are as previously defined. Thus on the west bank of the Nile between Luxor and Qena, a 1 mi^2 of the drainage basin will contain a channel 3.87 miles long.

The value of the exponent is an indication of the proportional increase of average width and length of the basin. A value of 0.5 would indicate that both the average width and length of the basin increase in the same proportion. A value greater than 0.5 indicates that as the area of the basin increases, length increases faster than width and the basin will tend to become elongate. The value of 0.6 in Hack's equation and 0.76 in our equation suggests a tendency toward narrow and elongate basins, which is shown in fig. 2. Miller (1958) has noted this tendency in arid basins, but it seems to be an inherent property of many basins (Ritter, 1978). Elongation appears also to be a function of slope and relief. Basins tend to become elongate

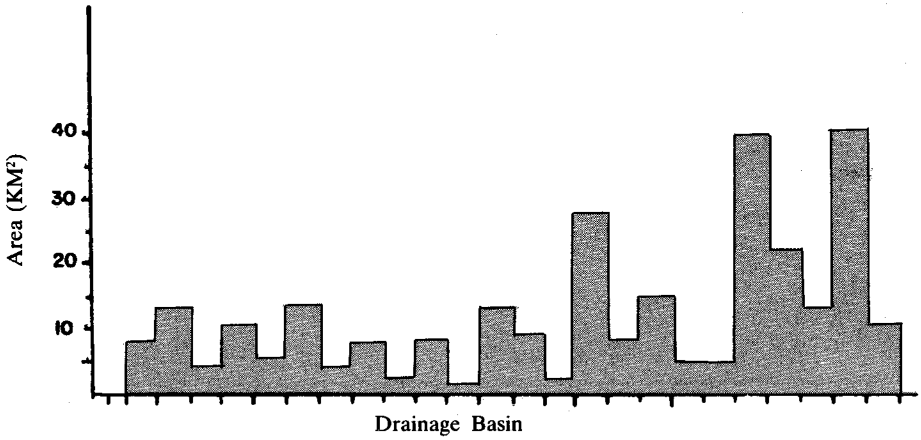

Fig. 8 Histogram of the studied basin area.

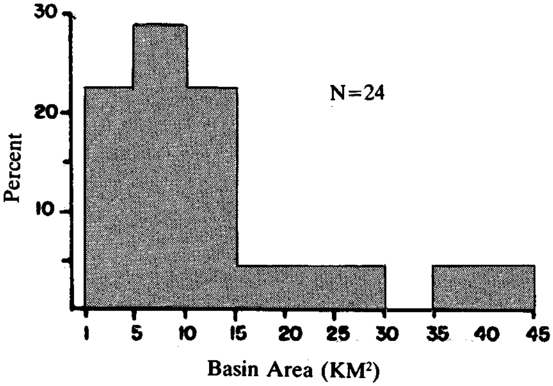

Fig. 9 Frequency distribution of the basin area.

with the strong relief and steep slope (Chorley, 1971). In order to obtain a measure of elongation, the elongation ratio was calculated. This ratio is the diameter of a circle having the same area as the basin, divided by the maximum basin length. The elongation ratio for these wadis ranges from 0.17 to 0.93, with an average of 0.47.

One of the important measures of the areal aspects of basins is drainage density because of its implications for runoff (Chorley, 1971) and climate (Gregory, 1976). Drainage density is given by the quotient of the cumulative length of the streams and the total drainage area. It is thus a measure of stream length per unit area. The average density for the 24 basins in the region under investigation is 1.85 ± 0.72. (Fig. 10) This low density is comparable to the densities obtained for other wadi basins in Egypt :

Table 5
Drainage density for drainage basins from Wadi Degla, East Cairo, and the Danfiq-Ballas region.

Drainage Density	*Basin*	*Reference*
1.90	Wadi El Tih	Abdallah et al 1977
1.38	Wadi Degla	Abdallah et al 1977
2.08 (1.6-3.3)	Wadis east of Cairo	Said and Beheiri, 1961
0.15-2.58	Wadis in the Sohag-Nag Hamadi region	Beheiri, 1967
1.85	Wadis in the Danfiq-Ballas region	This work

In a study of the climatic implications of drainage density, Gregory (1976) concluded that drainage density tends to be highest in semiarid areas and tends to be lowest in humid temperature regions. He also showed that in arid regions the density also tends to be low. In a graph presenting variation in drainage density with precipitation (Gregory 1976: 10.3), the density is very low below annual rainfall of about 250 mm. Schumm (1971) also indicates that stream frequency (number of channels per unit area) is least in arid regions. Determination of the stream frequency for the basins in the area under study (Fig. 11) revealed that it ranges from 0.79 to 10.91, with an average of 3.36 and a large standard deviation of 2.91. In general, both the drainage density and the stream frequency are low, suggesting that the wadi drainage network was formed under arid climatic

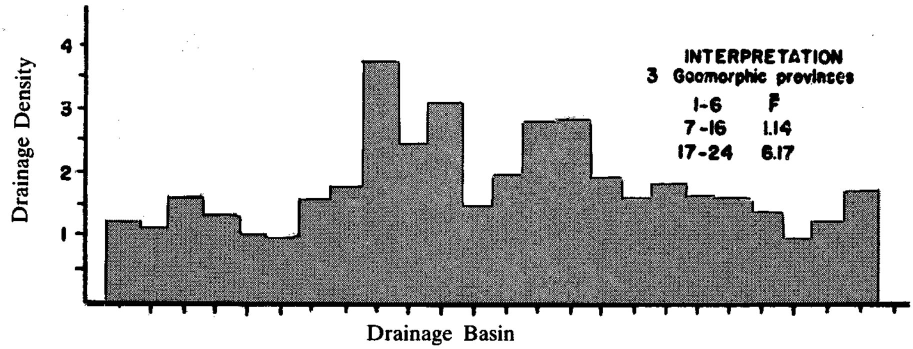

Fig. 10 Relationship between drainage basin and drainage density.

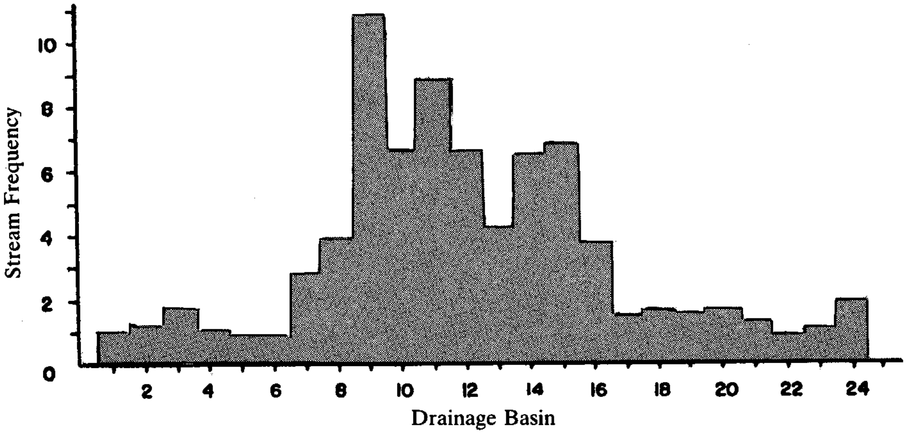

Fig. 11 Stream frequency in the studied drainage basins.

conditions, but we must assume that the rainfall was significantly greater than that at present. Although it is difficult to provide reliable figures on the amount of annual rainfall, it may be guessed from comparison with stream density in arid lands that it formed under annual rainfall in the range from 25 to 250 mm. Relatively moist conditions during the Pleistocene period in Egypt are documented at various times both in the Western Desert and along the Nile Valley. Wendorf and Schild (1980) infer the following humid-moist periods for the Western Desert of Egypt :

Early Holocene (9000-8500, 8200-7900, 7700-5800)	Moist
Middle Palaeolithic	Moist
Late and Final Acheulian	Humid

Butzer and Hansen (1968) indicate that records of rainy conditions in Southern Egypt as indicated by alluviation in desert wadis are as follows :

ca. 9000-ca 7000 B. P. (Sinqari Member, Inebia Formation)	Moist
17,000-12,500 B. P. (Malki Member, Inebia Formation) or older	Moist
ca. 60,000 (Korosko Formation)	Humid

The wadi network is incised in sediments of different ages. The wadis have their source in the Thebaid Plateau which is made of Eocene limestone and incise their way across Pliocene gravels (in places) and Quaternary Nile sediments, which consist mostly of sand and silt. The drainage network is incised in sediments that are younger than the Sinqari Member of the Inebia Formation which cap sediments of the Sahaba Formation and thus the development of the drainage network appears to represent a long history of development that continues past 7000 B.P. and is perhaps related to episodes of slight increase in rainfall than that of the present, which is practically nil. The incision of wadis thus seems to be associated with intervals of rainfall that are perhaps not greater than 50 mm. The growth of the network through time also suggests that the wadis were superimposed.

The inference on the arid conditions under which the drainage network was formed may be substantiated by considering the relationship between mean annual flood, i.e., flood equalled or exceeded on an average of once every 2.33 years (Q2.33) and basin area :

$$Q_{2.33} = 12_{A}0.79 \text{ (Chorley, 1971)}$$

Given an average area of 4.67 mi^2, the Q2.33 is estimated roughly as 13.6 cfs, a very small discharge that is also substantiated by the relationship between Q2.33 per square mile and drainage density :

$$Q2.33 \text{ per square mile} = 1.3D^2 \text{ (Carlston, 1963)}$$

which yields a figure of 20.8 cfs for the average basin area. These figures, though by no means definitive suggest floods that are on the average very small, and are most likely associated with very limited rainfall. Also given the slope in the area which varies from less than 0.9 to 2.3 degrees and the low stream frequency suggest a desert morphogenetic environment on the basis of Peltier's investigations.

It must be noted here, however, that the stream density and stream frequency are also controlled by local geology (structures and lithology). The wadi drainage network is mostly incised in surficial sediments of sand, gravel, and silt with high infiltration capacity which tends to reduce the developing drainage density. It has, also been noted that wide variations exist in the region in drainage density (1.85 ± 0.72) and stream frequency (3.36 ± 2.91). This wide variation, however, reflected a distinct aerial differentation (fig. 2). The middle sector of the region where basins 7—16 are located showed a consistently higher density and frequency than the basins in the northern or southern sectors (table 6). When this pattern was recognized, an investigation of the local geology revealed that the low desert in this sector is bounded by a titled fault block and that the solpe there is more steep than in either the northern or southern sectors. The increase in drainage density and stream frequency thus resulted from structual control (greater slope due to faulting). The relation between slope and density is shown in Fig. 12.

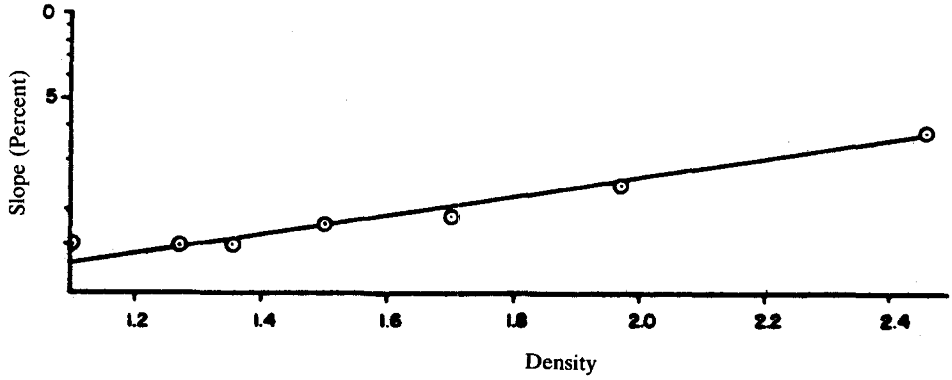

Fig. 12. Relation between the slope percent and drainage density.

Table 6

Mean drainage morphometric data of three sectors in the El-Zaweida-Danfiq region.

	Basins 1—6	Basins 7—16	Basins 17.24
Total Length	11.06 ± 4.13	17.79 ± 15.42	29.28 ± 21.34
(A) Area	9.35 ± 4.16	8.51 ± 8.13	19.17 ± 14.19
(D) Density	1.24 ± 0.24	2.42 ± 0.77	1.59 ± 0.28
L_D	0.83 ± 0.14	0.453 ± 0.138	0.649 ± 0.14
F	1.14 ± 0.036	5.839 ± 2.66	1.52 ± 0.38
F/D^2 Relative Density	0.749 ± 0.14	1.018 ± 0.22	0.61 ± 0.11
W. M. Bif. Ratio	3.09 ± 0.67	3.941 ± 1.25	3.88 ± 0.83
D^2	1.58 ± 0.26	6.36 ± 4.02	2.6 ± 0.83

Another intra-regional difference in basin morphometry is the concentration of large basins in the southern sector (Fig. 2). This appears to be primarily a function of the deposits at the head of the catchment area which consist of Pliocene gravel instead of the more resistant limestone.

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قياسات مورفومترية لبعض الوديان الموجوده بين دنفيق والبلاص بالضفة الغربية للنيل

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ملخص

أظهرت التحليلات الكمية والخطية لعدد ٢٤ حوضاً لتصريف المياه (وديان) للضفة الغربية لوادي النيل في المنطقة بين دنفيق والبلاص ـ الأقصر ـ قنا . الآتي :

١ ـ تتعامد خطوط الوديان الرئيسية على مجرى وادي النيل والتغير في اتجاهات الوديان يتحكم فيه التغير في مجرى النيل .

٢ ـ تتبع العلاقة بين أطول الوديان وعددها ورتبها قانون هورتون .

٣ ـ يبلغ درجة التفرع ٣ر٨٢ وهي تشابه نفس القيمة لاحواض شرق القاهرة والتي يبلغ فيها درجة التفرع ٣ر٨ ، ٣ر٧٨ .

٤ ـ العلاقة بين طول المجرى المائي ومساحته هول = ٣ر٨٧P ٧٦ر وهي تعني أن الحوض يميل إلى الاستطالة كلما كبرت مساحته .

٥ ـ ومتوسط الكثافة هو ١ر٨٥ + ٧٢ر وهو يدل على كثافة قليلة مثل معظم الاحواض في جمهورية مصر العربية .

٦ ـ وقد لوحظ تأثير التراكيب الجيولوجية على الوديان والذي ينعكس في كثافتها وانتشارها .

٧ ـ ونسبة انتشار الاودية تظهر أن هذه الوديان قد وصلت الى حالة التعادل .