

GENETIC INFLUENCES ON THE  
NATURE AND PROPERTIES OF BASAL  
MELT OUT TILLS

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Average Size	Symbol	Mathematical Definition (Summation between $i=1$ and $i=n$ )	Equivalent Natural Logarithms in Terms of Statistical Parameters of Distribution Curve by Number, $\bar{M}_n$ and $\sigma_n$
Geometric mean on weight basis	$\bar{M}_g$	$\frac{\sum n_i M_i^4}{\sum n_i M_i^3}$	$\ln \bar{M}_n + 3.0 \ln^2 \sigma_n$
Arithmetic mean on number basis	$\bar{M}_{an}$	$\frac{\sum n_i M_i}{\sum n_i}$	$\ln \bar{M}_n + 0.5 \ln^2 \sigma_n$
Surface area	$\bar{M}_{sa}$	$\left\{ \frac{\sum n_i M_i^2}{\sum n_i} \right\}^{1/2}$	$\ln \bar{M}_n + 1.0 \ln^2 \sigma_n$
Volume	$\bar{M}$	$\left\{ \frac{\sum n_i M_i^3}{\sum n_i} \right\}^{1/3}$	$\ln \bar{M}_n + 1.5 \ln^2 \sigma_n$
Specific surface area	$\bar{M}_s$	$\frac{\sum n_i M_i^3}{\sum n_i M_i^2}$	$\ln \bar{M}_n + 2.5 \ln^2 \sigma_n$

TABLE 4.1 CONSTRUCTION DETAILS OF NORWEGIAN DAMS (AMER KJÆRSVELI, 1968).

No. Name	Year of Construction Owner	Height m Volume, 1000 m <sup>3</sup>	CREST		CORE					Transition	Supporting fill	Bedrock
			Length m Width m	Form	Material Source	Compaction	k m/sec	P <sub>d opt.</sub> t/m <sup>3</sup>	W <sub>opt.</sub> %			
2 Bordel I	1958-9 NVE	42 300	300 7	Curved upstream R=350m	Moraine	8 t vibrating roller, 0.6m layers	2.10 <sup>-1</sup>	2.05	7.5	Sandy gravel compacted as supporting fill	Gravel placed in 0.6 m layers, sluiced and compacted with 8 t vibr. roller	Gneiss Granite
7 Arestaddele	1961-63 Norak Hydro	59 450	303 7	Curved upstream R=400 m	Moraine	15 t tractor 0.25m layers	7.10 <sup>-4</sup>	2.10	9.0	Sandy gravel and tunnel spoil	Quarried rock, 5 m layers, Sluiced.	Crystalline limestone
12 Tunhovd	1964-65 NVE	37 261	320 7	Curved upstream	Moraine	8 t vibrating roller, 0.6 m layers	9.10 <sup>-3</sup>	2.15	7.5	Sandy gravel	Downstream: Tunnel spoil placed in 1-5 m layers and sluiced. Upstream: Quarried rock, partly buoyed in water	Calcareous Gneiss
13 Hyttejuvet	1963-65 Norak Hydro	93 1,435	350 7	Curved upstream	Moraine	15 t tractor 0.25m layers	7.10 <sup>-4</sup>	2.17	7.8	Sandy gravel and tunnel spoil	Quarried rock, 5m layers, sluiced	Mica Schist
17 Akerlevatn	1964-67 NVE	53.5 1,085	485 7	Curved upstream	Moraine	8 t vibrating roller, 0.7m layers	1.10 <sup>-3</sup>	2.15	8.5	Gravely sand and tunnel spoil	Quarried rock, 5m layers, sluiced	Schist
18 Kvelven	1965-67 NVE	48.5 400	390 6	Curved upstream	Moraine	8 t vibrating roller, 0.6m layers	1.10 <sup>-3</sup>	2.14	9.5	Gravely sand and tunnel spoil	Quarried rock, 5m layers, sluiced	Mica Schist
22 Vasselivatn	1967 Siftråndeleg Elektrisit- tets verk	25 70	150 5	Curved upstream R=155m	Moraine	15 t tractor 0.25 m layers	3.10 <sup>-3</sup>	2.17	7.5	Gravely sand	Tunnel spoil, 1.5 m layers, sluiced	-
27 Fellejord	1965-69 NVE	74 940	565 6	Curved upstream, R=155m	Moraine	10 t vibrating roller, 0.6m layers	2.10 <sup>-3</sup>	2.14	7.5	Gravely sand and tunnel spoil	Quarried rock, 5m layers sluiced	Amphibolite and Gneiss Mica Schist
28 Ranndals	1968-69 Sundebæra Kraftwerk	26.5 114	110 5	Curved upstream, R=210m	Moraine	4.4 t vibrating roller, 0.6m layers	5.10 <sup>-3</sup>	2.14	7.3	Sandy gravel	Tunnel spoil, 1.5m layers, sluiced	Quartzite
51 Drøvledals- vatn	1971-72 NVE	29 192	340 5	Partly curved upstream, R=100m	Moraine	15 t tractor, 0.25m layers	4.10 <sup>-2</sup>	2.16	7.6	Sandy gravel and tunnel spoil	Tunnel spoil 1.5m layers, sluiced. Quarried rock, 5 m layers, sluiced.	Gneiss with Amphibolite and mica layers.
52 Vetra	1971-72 Flåmsdals Kraftwerk	28 173	310 5	Curvilinear, R=150m	Moraine	8 t vibrating roller, 0.6 m layers	3.10 <sup>-3</sup>	2.14	7.3	Sandy gravel and tunnel spoil	Quarried rock, 3 m layers, sluiced.	Gneiss Granite
55 Jukkavatn	1971-73 NVE	58 610	350 3	Straight	Moraine	10 t vib. sing rolle, 0.6m layers	5.10 <sup>-2</sup>	2.15	7.1	Gravels and tunnel. spoil	Quarried rock, 5m layers, sluiced	-
66 Bygstad I	1971-73 NVE	58 210	260 5	Partly curved down- stream R=35m	Moraine	Tractor, 0.25m layers	3.10 <sup>-2</sup>	2.12	8.0	Gravel and tunnel spoil	Tunnel spoil, 1.5m layers, Quarried rock, 5m layers.	Gneiss Granite

Table 4.2 - GEOTECHNICAL PROPERTIES OF TILL MATERIALS IN CANADIAN DAMS (After McDonald et al, 1961)

No.	DAM OR DYKE				IMPERVIOUS FILL MATERIAL					PLACING CONDITIONS	
	Name year of completion	Type (A) Max. height (m)	k( $\mu\text{m/sec}$ ) Max. Hydr Gradient	$L_L$ (%) $P_L$ (%)	$w_{opt.}$ (%) (b) $f_d$ Max. ( $t/m^3$ )	$G_s$	SHEAR STRENGTH		Compaction Method	Av. Field Comp' Water Content (% of Proctor)	
							At $w_{opt.}$	At 125% of $w_{opt.}$			
GLACIAL TILLS-PLASTIC											
6	Niagara Storage 1957	RS 20.6	$0.025$ $2.8 \times 10^{-4}$	41 21	20 1.66	2.70	-	23-26 4.8	Sheepsfoot Roller	92 105	
7	Conestogo 1957	EH 30.9	$0.05$ $0.7 \times 10^{-4}$	20-32 11-17	10-17 2.03- 1.81	2.67	-	-	Pneumatic Tired Roller	95-100 100	
8	Fanshawe 1952	EC 30.9	$0.005$ $1.3 \times 10^{-4}$	15-25 13-18	- -	2.65	-	-	Construct- ion Equip- ment	95-100 100	
9	St. Mary 1950	EH 60.6	- $0.8 \times 10^{-4}$	35 14	15 1.81	2.71	28 20.3	-	Sheepsfoot Roller	94 95	
GLACIAL TILLS-NON PLASTIC											
11	Menihek 1953	EH 12.1	$0.3$ $1.2 \times 10^{-4}$	16 14	10 2.11	2.63 2.74	28 19.1	-	Sheepsfoot Roller	80-100 95	
14	Sisson 1952	EH 25.7	$2.5$ $0.4 \times 10^{-4}$	" -	12-18 1.97-1.75	- -	-	-	Sheepsfoot Roller	80-120 90-105	
15	Lake St. Anne 1958	RS 36.3	$15.0$ $4.5 \times 10^{-4}$	Non- Plastic Silty Till	8 2.05	2.73	39 22.7	39 16.7	Construct- ion Equip- ment	101 96	
16	Bersimis No. 1 1955	RS 68.2	$2.0$ $6.0 \times 10^{-4}$	Non- Plastic Silty Till	9 2.16	2.72	35.5 65.5	38.0 51.6	Construct- ion Equip- ment	101 98	
17	Cornwall 1958	EH 25.7	$0.25$ $0.5 \times 10^{-4}$	14 10	10 2.11	2.71	-	39 0	Sheepsfoot Roller	96 101	
18	Shand 1942	EH 22.7	$0.06$ $0.6 \times 10^{-4}$	- -	9 2.14	2.74	32 46.4	-	Sheepsfoot Roller	129 92	

Notes -(A) EH - Earthfill, Homogeneous Section

EC - Earthfill, Central Core

RS - Rockfill, Sloping Core

(B) Measured in Standard Proctor Test.

TABLE 5.1 CLASSIFICATION OF SOME SCOTTISH TILLS

LOCATION	COWAL ROAD SITES	CORROUR FOREST FERSIT ROAD	CORROUR FOREST GHIULBINN ROAD	CORROUR FOREST STRATH- OSSIAN WAY	GLEN GARRY FOREST GLEN KINGIE	STRATHYRE FOREST	GLEN ORCHY FOREST
LITHOLOGY	MICA SCHIST	GRANITE	GRANITE	GRANITE	GRANULITE	QUARTOZE MICA SCHIST	QUARTZITE AND MICA SCHIST
PARTICLE SIZE GRADING	FIGS. 5.16 to 5.20	FIG. 27	FIG. 28	FIG. 29	FIGS. 5.37 to 5.39	FIGS. 5.46	FIGS. 5.51 to 5.54
SPLIT SIZE $\phi$	0.6 0.8	2.0 -1.0	0.8 0.3	0.8 0.3	0.4 1.3	0.4 1.3	0.2 2.3
RANGE % FINES FOR 100 mm DIAMETER	23-95% 53% Average	45-73% 58% Average	43-63% 52% Average	28-52 48% Average	10-66 30% Average	25-58 53% Average	5-25 14% Average
CLASSIFICATION OF FINE SOIL FRACTION (MATRIX)							
ACCORDING TO B.S. 1377	SILTY SAND	SILTY SAND	SILTY SAND	SILTY SAND	SILTY SAND	SILTY SAND	SILTY SAND
MODIFIED WENT- WORTH SCALE	COARSE SILT FINE TO V. FINE SAND	SILT SAND	COARSE SILTY V. FINE TO MEDIUM SAND	COARSE SILTY V. FINE TO MEDIUM SAND	MEDIUM TO COARSE SILT - FINE SAND	COARSE SILTY v. fine SAND	COARSE SILT v. fine SAND
DOEGLAS'S INDICES (Q)	Q <sub>1</sub> M <sub>D</sub> Q <sub>3</sub> Max. 5.7 4.8 3.1 Aver. 5.5 3.7 2.5 Min. 4.1 2.6 1.7	Q <sub>1</sub> M <sub>D</sub> Q <sub>3</sub> 4.6 2.3 0.7 3.9 1.8 0.4 3.2 1.3 0.0	Q <sub>1</sub> M <sub>D</sub> Q <sub>3</sub> 4.5 3.1 1.8 4.0 3.0 1.75 3.8 2.9 1.7	Q <sub>1</sub> M <sub>D</sub> Q <sub>3</sub> 4.4 2.9 1.5 3.8 2.5 1.3 3.2 2.1 1.1	Q <sub>1</sub> M <sub>D</sub> Q <sub>3</sub> 6.2 4.1 2.2 4.7 3.1 1.9 3.3 2.3 1.6	Q <sub>1</sub> M <sub>D</sub> Q <sub>3</sub> 5.5 4.0 2.9 5.0 3.8 2.8 4.7 3.5 2.7	Q <sub>1</sub> M <sub>D</sub> Q <sub>3</sub> 5.8 4.1 3.1 4.8 3.5 2.8 4.0 2.8 2.4

TABLE 5.2 CLASSIFICATION OF SOME SCOTTISH AND MODERN GLACIAL TILLS

LOCATION	GLEN TROOL CAIRN EDWARD FOREST (BENNEN)	GLEN TROOL GARCROGO FOREST	GLEN TROOL GARRARIES FOREST	BACKWATER DAM, UPPER SILTY TILL	BACKWATER DAM - NORTH BORROW PIT	BLAISEN HARDANGER - JOKULLEN	LACROIX GLACIER ANTARCTICA	
LITHOLOGY	GRANITE GREYWACKE	GRANITE GREYWACKE	GRANITE GREYWACKE	SCHISTOZE GRIT/MICA SCHIST	SCHISTOZE GRIT/MICA SCHIST	GRANITE - GNISS PHYLLITE	GRANITE - GNISS	
PARTICLE SIZE GRADING	Fig. 5.61	Fig. 5.62	Fig. 5.63	Fig. 5.71	Fig. 5.75	Fig. 5.85	Fig. 5.90	
AVERAGE SPLIT SIZE	mm $\varnothing$	0.6 0.8	0.3 1.3	0.2 0.1	0.2 2.3	0.2 2.3	0.11 3.2	0.095 3.4
RANGE OF % FINES FOR 100 mm DIAMETER	20-50% 34%	9-35% 25%	35-54% 47%	30-66% 48%	50-65% 57%	26-45% 38%	50%	
CLASSIFICATION OF FINE SOIL FRACTION (MATRIX)								
ACCORDING TO B.S. 1377	Silty Sand	Silty Sand	Silty Sand	Clayey Silt with Sand	Clayey Silt with Sand	Clayey Silt	Clayey Silt	
MODIFIED WENTWORTH SCALE	Coarse Silty Fine to very Fine Sand	Medium Coarse Silt - Fine to V. Fine sand	Medium Coarse Silt - Fine to V. Fine Sand	Clayey Silt with V. Fine Sand	Clayey Silt with V. Fine Sand	Clayey V. Fine to Coarse Silt	Clayey V. Fine to Coarse Silt	
DOEGLAS'S INDICES ( $\varnothing$ SCALE)	$Q_1$ $M_d$ $Q_3$ MAX. 6.2 3.8 2.1 AVER. 4.9 2.9 1.8 MIN. 3.8 2.1 1.4	$Q_1$ $M_d$ $Q_3$ 5.8 4.1 3.0 5.3 3.5 2.5 4.8 2.8 2.0	$Q_1$ $M_d$ $Q_3$ 5.2 3.3 2.0 5.0 3.1 1.9 4.8 2.9 1.7	$Q_1$ $M_d$ $Q_3$ 10.0 5.7 4.1 7.8 5.1 3.8 6.1 4.7 3.3	$Q_1$ $M_d$ $Q_3$ 10.3 5.8 4.1 8.4 5.1 3.8 7.0 4.6 3.4	$Q_1$ $M_d$ $Q_3$ 8.3 6.7 5.6 7.8 6.3 5.4 7.3 5.9 5.1	$Q_1$ $M_d$ $Q_3$ 7.4 5.8 4.6	

TABLE 5.2 CLASSIFICATION OF NORWEGIAN DAM TILLS (2 - 22)

TABLE 5.3 CLASSIFICATION OF NORWEGIAN DAM TILLS (2 - 22)

LOCATION	BORDAL	ARSTADDALEN	TUNHOVD	HYTTEJUVET	AKERSVATN (UMSKARAT)	KALVATN (SPRUTFUSS- MYRA)	VASSLIVATN
DAM NO.	2	7	12	13	17	18	22
LITHOLOGY	Gneiss - Granite	Crystalline Limestone	Caicitic Diabase	Mica Schist	Schist	Mica Schist	?
PARTICLE SIZE GRADING	Fig. 5.93	Fig. 5.94	Fig. 5.95	Fig. 5.96	Fig. 5.97	Fig. 5.98	Fig. 5.99
AVERAGE SPLIT SIZE	mm $\phi$	0.2 2.3	0.1 3.3	0.15 2.8	0.1 3.3	0.13 3.0	0.22 2.1
RANGE OF % FINES FOR 20 mm DIAMETER	28 - 50% 35% Average	47 - 70% 59% Average	38 - 67% 48% Average	35 - 54% 50% Average	38 - 60% 53% Average	47 - 83% 62% Average	32 - 57% 40% Average
CLASSIFICATION OF FINE SOIL FRACTION ( MATRIX)							
ACCORDING to B.S. 1377	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt	Sandy Silt
MODIFIED WENTWORTH SCALE	V. Fine Sand V. Fine to Coarse silt.	Clayey - V. Fine to Coarse silt	V. Fine to Fine sand - V. Fine to Coarse silt.	Clayey - V. Fine to Coarse silt			
TYPICAL DOEGLAS'S GRAIN SIZE INDICES ( $\phi$ )	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub>	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub>	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub>	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub>	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub>	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub>	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub>
	6.7 4.3 3.2	9.1 6.0 4.3	7.8 5.9 4.5	9.5 7.0 5.1	7.2 5.6 4.4	6.2 4.7 3.0	7.1 4.9 2.9

TABLE 5.4 CLASSIFICATIONS OF NORWEGIAN DAM TILLS ( 27 - Ex 1 )

LOCATION	FOLLSJO	MANDALA	DRAVLA-DALSVATN	VOTNA	JUKLAVATN	MYSEVATN	STOLSVATN
DAM NO.	27	28	51	52	55	56	Ex 1
LITHOLOGY	Amphiolite and Gneiss Mica Schist	Quartzite	Gneiss with Amphiolite And Mica Layers	Gneiss Granite	?	Gneiss Granite	Gneiss
PARTICLE SIZE GRADING	Fig. 5.100	Fig. 5.101	Fig. 5.102	Fig. 5.102	Fig. 5.102	Fig. 5.102	Fig. 5.103
AVERAGE SPLIT SIZE mm Ø	0.28 1.9	0.19 2.4	0.15 2.8	0.38 1.4	0.7 0.6	0.3 1.7	0.15 2.8
RANGE OF % FINES FOR 20mm DIAMETER	14 - 70% 48% Average	34 - 68% 54% Average	51%	52%	48%	49%	22 - 49% 40% Average
CLASSIFICATION OF FINE SOIL FRACTION ( MATRIX )							
ACCORDING TO B.S. 1377	Sandy	Sandy	Sandy	Silty	Silty	Silty	Sandy
MODIFIED WENTWORTH SCALE	Silt	Silt	Silt	Sand	Sand	Sand	Silt
DOEGLAS'S GRAIN SIZE INDICES (Ø)	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 6.6 4.8 3.0	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 5.9 4.2 3.4	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 5.7 4.3 3.6	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 4.8 3.3 2.3	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 5.2 3.4 2.0	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 5.1 3.8 2.7	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 5.2 4.1 3.5

TABLE 5.5 CLASSIFICATION OF CANADIAN DAM TILLS (After McDonald et al 1961)

LOCATION	NIAGARA STORAGE (6)	CONESTOGO (7)	FANSHAWE (8)	ST. MARY (9)	MENIHEK (11)	SISSON (14)	LAKE ST. ANNE (15)	BERSIMIS NO. 1 (16)	CORNWALL (17)	SHAND (18)	
LITHOLOGY				NOT GIVEN							
PARTICLE SIZE DISTRIBUTION	Fig.5.112	Fig.5.112	Fig.5.112	Fig.5.112	Fig.5.113	Fig.5.113	Fig.5.113	Fig.5.113	Fig.5.113	Fig.5.113	
SPLIT SIZE	mm $\phi$	0.052 4.3	0.06 4.1	0.026 5.3	0.04 4.8	0.4 1.3	0.68 0.6	0.6 0.8	0.56 0.9	0.18 2.4	0.35 1.5
% FINES FOR A MAXIMUM DIAMETER (mm)	85% (max 2mm)	73% (max 4mm)	48% (max 8mm)	73% (max 0.4mm)	72% (max 20mm)	44% (max 15mm)	70% (max 20mm)	72% (max 20mm)	48% (max 20mm)	71% (max 20mm)	
CLASSIFICATION OF FINE SOIL FRACTION (MATRIX)											
ACCORDING TO B.S. 1377	Clayey Silt	Clayey Silt	Clayey Silt	Clayey Silt	Silty Sand	Sandy Clayey Silt	Silty Sand	Silty Sand	Sandy Silt	Sandy Clayey Silt	
MODIFIED WENTWORTH SCALE	Clayey very fine to Coarse Silt	Clayey very Fine to Coarse Silt	Clayey very fine to Medium Silt	Clayey very Fine to Coarse Silt	Medium to coarse silty very Fine to Coarse Sand	Silty Clayey Sand	Silty very fine to Coarse Sand With Clay	Silty very fine to Coarse Sand	Fine to very Fine Sandy Silt with Clay	Medium to very Fine Sandy Silt With Clay	
DOEGLAS'S INDICES ( $\phi$ SCALE)	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 9.6 7.8 6.2   9.6 7.6 5.8	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 9.9 8.1 6.9 .10 8.7 6.6	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 3.9 2.6 2.0	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 9.3 6.1 2.8	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 4.9 2.5 1.9	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 5.1 3.7 2.0	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 7.4 5.4 3.9	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 8.6 5.9 3.7			

TABLE 5.6 CLASSIFICATION OF VARIOUS CANADIAN TILLS

LOCATION	SHAND DAM	52% DOLOMITIC TILL ONTARIO	67% DOLOMITIC TILL ONTARIO	77% DOLOMITIC TILL ONTARIO	VILLE LA SALLE	ILE HERON
LITHOLOGY	Dolomite	As Above	As Above	As Above	Not Known	Not Known
PARTICLE SIZE DISTRIBUTION	Fig. 5.119	Fig. 5.124	Fig. 5.124	Fig. 5.124	Fig. 5.129	Fig. 5.130
SPLIT SIZE mm Ø	0.35 1.5	0.14 2.9	0.19 2.4	0.055 4.2	0.03 5.1	0.04 4.7
% FINES FOR MAXIMUM DIAMETER	50-87% 74% Average (max. 100mm)	69% (Max. 30 mm)	56% (Max. 50 mm)	21% (Max. 60mm)	3-78% 30% Average (Max. 100 mm)	20-60% 50% Average (Max. 100 mm)

## CLASSIFICATION OF FINE SOIL FRACTION (MATRIX)

ACCORDING TO B.S. 1377	Sandy Clayey Silt	Sandy Clayey Silt	Sandy Silt	Sandy Silt	Clayey Silt	Clayey Silt
MODIFIED WENTWORTH SCALE	Medium to Very Fine Sandy Silt with Clay	Very Fine Sandy Silt with Clay	Fine to Very Fine Sandy Silt with Clay	Very Fine Sandy Silt	Clayey Very Fine to Medium Silt	Clayey Very Fine to Coarse Silt
DOEGLAS'S INDICES (Ø SCALE)	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 8.6 5.9 3.8	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 7.9 6.1 4.6	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 6.8 5.1 3.7	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 6.0 4.8 4.0	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 8.5 6.9 6.0	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 8.3 6.8 5.5

TABLE 5.7 CLASSIFICATION OF KRUMBEIN'S VALPARAISO TILLS ( 1 - 8 )

LOCATION	1	2	3	4	5	6	7	8
LITHOLOGY	AS SHOWN IN FIG. 5.148							
PARTICLE SIZE DISTRIBUTION	Fig. 5.136	Fig. 5.136	Fig. 5.136	Fig. 5.136	Fig. 5.136	Fig. 5.136	Fig. 5.137	Fig. 5.137
SPLIT SIZE	mm Ø	0.05 4.4	0.048 4.5	0.030 5.1	0.055 4.25	0.042 4.6	0.040 4.7	0.050 4.4
% FINES ( MAX. SIZE OF COARSE 1 mm )	70	76	73	68	88	84	83	77
CLASSIFICATION OF FINE SOIL FRACTION (MATRIX)								
ACCORDING TO B.S. 1377	CLAYEY SILT	CLAYEY SILT	CLAYEY SILT	CLAYEY SILT	CLAYEY SILT	CLAYEY SILT	CLAYEY SILT	CLAYEY SILT
MODIFIED WENTWORTH SCALE	COARSE TO V. FINE SILTY CLAY	COARSE TO V. FINE SILTY CLAY	COARSE TO V. FINE SILTY CLAY	COARSE TO V. FINE SILTY CLAY	COARSE TO V. FINE SILTY CLAY	COARSE TO V. FINE SILTY CLAY	COARSE TO V. FINE SILTY CLAY	CLAYEY V. FINE TO COARSE SILT
DOEGLAS INDICES ( Ø SCALE )	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 9.9 7.6 5.9	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 10.0 7.85 6.3	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 10.2 8.3 6.7	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 10.5 8.0 6.0	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 9.8 7.9 6.4	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 9.85 7.7 6.35	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 10.3 8.0 6.5	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub> 8.95 7.1 5.95

TABLE 5.8 CLASSIFICATION OF KRUMBEIN'S VALPARAISO TILLS (9 ~ 16)

LOCATION	9	10	11	12	13	14	15	16
LITHOLOGY	AS SHOWN IN FIG. 5.148							
PARTICLE SIZE DISTRIBUTION	FIG. 5.137	FIG. 5.137	FIG. 5.137	FIG. 5.137	FIG. 5.138	FIG. 5.138	FIG. 5.138	FIG. 5.138
SPLIT SIZE	mm Ø	0.069 3.95	0.07 3.9	0.026 5.3	0.052 4.3	0.045 4.6	0.05 4.4	0.04 4.7
% FINES ( MAX SIZE OF COARSE 1 mm )	86	88	80	83	80	78	56	62
CLASSIFICATION OF FINE SOIL FRACTION ( MATRIX )								
ACCORDING TO B.S. 1377	CLAYEY SILT	CLAYEY SILT	CLAYEY SILT	CLAYEY SILT	CLAYEY SILT	CLAYEY SILT	CLAYEY SILT	CLAYEY SILT
MODIFIED WENTWORTH SCALE	CLAYEY COARSE TO V. FINE SILT	COARSE TO V. FINE SILTY CLAY	COARSE TO V. FINE SILTY CLAY	COARSE TO V. FINE SILTY CLAY	CLAYEY COARSE TO V. FINE SILT	CLAYEY COARSE TO V. FINE SILT	COARSE TO V. FINE SILTY CLAY	COARSE TO V. FINE SILTY CLAY
DOEGLAS INDICES (Ø SCALE)	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub>	9.9 7.7 5.95 10.4 8.0 6.2 10.3 8.8 7.1 10.3 8.1 6.3 9.4 7.3 6.0 10.0 7.4 5.9 10.2 7.7 6.0 10.3 7.8 6.3						

TABLE 5.9 CLASSIFICATION OF KRUMBEIN'S VALPARAISO TILLS ( 17 - 24 )

LOCATION	17	18	19	20	21	22	23	24
LITHOLOGY	AS SHOWN IN FIG. 5.148							
PARTICLE SIZE DISTRIBUTION	FIG. 5.138	Fig. 5.138	Fig. 5.139					
SPLIT SIZE	mm Ø	0.046 4.5	0.034 5.0	0.020 5.7	0.021 5.6	0.018 5.9	-	0.021 5.6
% FINES (MAX. SIZE OF COARSE 1 mm )	80	78	74	69	57	-	55	52
CLASSIFICATION OF FINE SOIL FRACTION ( MATRIX )								
ACCORDING TO B.S. 1377	Clayey Silt	Clayey Silt	Clayey Silt	Clayey Silt	Clayey Silt	-	Clayey Silt	Silty Clay
MODIFIED WENTWORTH SCALE	Coarse to V Fine Silty Clay	Coarse to V. Fine Silty Clay	-	Coarse to V. Fine Silty Clay	Medium to Fine Silty Clay			
DOEGLAS INDICES ( Ø SCALE )	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub>							
	10.2 7.9 6.3	10.3 8.4 6.9	10.5 8.6 7.1	10.1 8.0 6.7	10.5 8.7 7.2	- - -	10.5 8.9 7.3	10.5 9.3 7.8

TABLE 5.10 CLASSIFICATION OF KRUMBEIN'S ILLINOIS TILLS ( A - H )

LOCATION	A	B	C	D	E	F	G	H
LITHOLOGY	AS SHOWN IN FIG. 5.164							
PARTICLE SIZE DISTRIBUTION	Fig. 5.150	Fig. 5.150	Fig. 5.150	Fig. 5.150	Fig. 5.151	Fig. 5.151	Fig. 5.151	Fig. 5.151
SPLIT. mm	0.072	0.07	0.065	0.060	0.031	0.028	0.033	0.029
SIZE $\varnothing$	3.8	3.9	4.0	4.1	5.1	5.2	4.95	5.15
% FINES ( MAX. SIZE 1 mm )	40	45	50	50	45	52	40	46
CLASSIFICATION OF FINE SOIL FRACTION ( MATRIX )								
ACCORDING TO B.S. 1377	Clayey Silt	Clayey Silt	Clayey Silt	Clayey Silt	Clayey Silt	Clayey Silt	Clayey Silt	Clayey Silt
MODIFIED WENTWORTH SCALE	Clayey V. Fine to Coarse Silt	Clayey V. Fine to Coarse Silt	Clayey V. Fine to Coarse Silt	Clayey V. Fine to Coarse Silt	Clayey V. Fine to Coarse Silt	Clayey V. Fine to Coarse Silt	Clayey V. Fine to Coarse Silt	Clayey V. Fine to Coarse Silt
DOEGLAS'S INDICES ( $\varnothing$ SCALE )	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub>	8.4 6.4 5.1 8.8 6.7 5.3 8.5 6.5 5.2 9.0 6.9 5.5 9.8 7.6 5.9 9.9 7.7 6.2 9.0 7.1 6.0 9.0 7.5 6.2						

TABLE 5.11 CLASSIFICATION OF KRUMBEIN'S ILLINOIS TILLS ( J - P<sub>I</sub> )

LOCATION	J	K	L	M	N	O	P	P <sub>I</sub>
LITHOLOGY	AS SHOWN IN FIG. 5.164							
PARTICLE SIZE DISTRIBUTION	Fig. 5.152	Fig. 5.152	Fig. 5.152	Fig. 5.153				
SPLIT mm	0.023	0.021	0.025	0.028	0.020	0.020	0.025	0.030
SIZE Ø	5.5	5.7	5.4	5.3	5.75	5.75	5.4	5.15
% FINES ( MAX. SIZE 1 mm )	68	66	65	77	60	77	88	88
CLASSIFICATION OF FINE SOIL FRACTION ( MATRIX )								
ACCORDING TO B.S. 1377	Clayey	Clayey	Clayey	Clayey	Clayey	Clayey	Clayey	Clayey
	Silt	Silt	Silt	Silt	Silt	Silt	Silt	Silt
MODIFIED WENTWORTH SCALE	Medium to Very Fine Silty Clay	Medium to Very Fine Silty Clay	Medium to Very Fine Silty Clay	Medium to Very Fine Silty Clay	Medium to Very Fine Silty Clay	Medium to Very Fine Silty Clay	Medium to Very Fine Silty Clay	Medium to Very Fine Silty Clay
DOEGLAS'S INDICES ( Ø SCALE )	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub>	10.0 8.1 6.8 9.6 7.6 6.6 9.6 7.9 6.6 9.6 7.7 6.6 9.5 7.6 6.7 9.9 7.9 6.9 10.5 8.4 7.1 10.5 9.0 7.4						

TABLE 5.12 CLASSIFICATION OF KRUMBEIN'S ILLINOIS TILLS ( Q - W )

LOCATION	Q	R	S	T	U	V	W
LITHOLOGY	AS SHOWN IN FIG. 5.164						
PARTICLE SIZE DISTRIBUTION	Fig. 5.154	Fig. 5.154	Fig. 5.154	Fig. 5.154	Fig. 5.154	Fig. 5.154	Fig. 5.154
SPLIT	mm	0.039	0.032	0.031	0.030	0.030	0.030
SIZE	Ø	4.8	5.0	5.1	5.15	5.15	5.00
% FINES ( MAX. SIZE 1 mm )	83	92	86	82	84	82	88
CLASSIFICATION OF FINE SOIL FRACTION ( MATRIX )							
ACCORDING TO B.S. 1377	Clayey Silt	Clayey Silt	Clayey Silt	Clayey Silt	Clayey Silt	Clayey Silt	Clayey Silt
MODIFIED WENTWORTH SCALE	Fine to very Fine Silty Clay	Fine to very Fine Silty Clay	Fine to very Fine Silty Clay	Fine to very Fine Silty Clay	Fine to very Fine Silty Clay	Fine to very Fine Silty Clay	Fine to very Fine Silty Clay
DOEGLAS'S INDICES ( Ø SCALE )	Q <sub>1</sub> M <sub>d</sub> Q <sub>3</sub>	10.2 8.1 6.7 10.5 8.6 7.1 10.5 8.8 7.2 10.3 8.2 6.7 10.3 8.4 7.0 10.3 8.4 7.0 10.2 8.7 7.0					

TABLE 6.1. MEAN PARTICLE SIZE DIFFERENCE IN TILLS.

SITE	MEAN PARTICLE SIZE * DIFFERENCE
Scottish Tills	
Cowal	0.02 to 0.014
Courrour	0.0014 to 0.021
Strathyre	0.005 to 0.007
Glen Orchy	0.008 to 0.011
Glen Trool	0.008 to 0.02
Backwater Dam	0.0085 to 0.01
Blaisen	0.0014 to 0.003
Norwegian Dams	
2	0.03
7	0.029
12	0.013
13	0.028
17	0.023
18	0.038
22	0.012
27	0.018
28	0.048
51	0.054
52	0.034
55	0.027
56	0.039
EX1	0.042

TABLE 6.1. (contd.)

SITE	MEAN PARTICLE SIZE * DIFFERENCE
Canadian Dams	
6	0.023
7	0.022
8	0.015
9	0.032
11	0.009
14	0.002
15	0.006
16	0.042
17	0.015
18	0.008
Montreal Ville la Salle	0.009
Ille Heron	0.066
Valparaiso	0.042
Illinois	0.087

\* Mean Particle Size Difference is taken as the ratio of the fine soil fraction D 50 size to the coarse soil fraction D 50 size when the maximum particle size is 100 mm diameter.

TABLE 6.2. PARTICLE ORGANISATION IN COAL TILL WHEN COMPACTED AT  
OPTIMUM BRITISH STANDARD CONDITIONS.

Percentage Fines Content	State of Particle Organisation
0 - 10	Clast Controlled
10 - 15	Clast dominated
15 - 37	Well graded
37 - 80	Matrix dominated
80 - 100	Matrix controlled

TABLE 6.3. RELATIVE APPARENT ABUNDANCE CLASSIFICATION.

RELATIVE ABUNDANCE OF A FORM.	REPRESENTATIVE SYMBOL.	DESCRIPTION
Not apparent	N.A.	No examples of this form are observable.
Rare	1.	Few examples of this form to be found.
Occasional	2.	Examples of this form are observable but not common.
Frequent	3.	A large number of forms of this type are to be found.
Dominant	4.	This form is very common and is dominant.

SOIL PROPERTIES	CENTRAL BREIDAMERKURJOKULL ICELAND	WEST BREIDAMERKURJOKULL ICELAND	BLAISEN NORWAY
LIQUID LIMIT (%)	16	20	18
PLASTIC LIMIT (%)	13	15	15
WATER CONTENT (%)	9	7.4	10
DRY DENSITY ( $t/m^3$ )	2.37	1.95	1.81
SPECIFIC GRAVITY	2.85	2.85	2.74
ROCK CONSTITUENTS	Basalt suite	Basalt suite	Granite-gneiss, phyllite

TABLE 6.4. AVERAGE PHYSICAL PROPERTIES OF NORWEGIAN AND ICELANDIC TILLS

SOIL PROPERTY	BREIDAMERKURJOKULL ICELAND	BLAISEN NORWAY
LIQUID LIMIT (%)	26	20
PLASTIC LIMIT (%)	19	14
WATER CONTENT (%)	60	44

TABLE 6. 5 PROPERTIES OF FROZEN TILLS FROM NORWEGIAN AND ICELANDIC GLACIERS

TABLE 6.6. PERCENTAGE OF CLASTS IN EACH OF SEVEN DESCRIPTIVE SHAPE  
CLASSES AND INDEXES OF FLATNESS FOR THE TILLS SAMPLED.

Descriptive shape classes	ICELAND			NORWAY	
	BR/C 17	BR/C 10	BR/W 3B	B/65/A	B/72/D
OVOID	8	16	24	20	8
RHOMBOHEDROID	20	16	8	12	12
TABULAR	14	20	8	20	20
DISCOID	2	-	-	12	16
WEDGE	40	28	44	24	28
ROD	14	14	12	8	16
VARIHEDROID	2	4	4	4	4
Number of clasts	100	75	50	50	50
Number of levels sampled	3	3	2	2	2
Index of flatness ( $I_f$ )*	173	197	185	217	225
Standard Deviation	46	144	48	65	81

$$*I_f = \frac{a+b}{2c} \cdot 100 \text{ (Cailleux 1947)}$$

SOIL		CLAY SIZE ARRANGEMENTS						GRANULAR ARRANGEMENTS			
		OVERALL PRESENCE	SINGLE PARTICLE GROUPS				PARTLY DIS- CERNIBLE ARRANGEMENTS	OVERALL PRESENCE	CLEAN GRAIN/GRAIN		CLOTHED GRAIN/GRAIN
BLAISEN NORWAY	1972		RANDOM	PARALLEL	RANDOM	PARALLEL		N.A.	4	3	3
	1965	1	3	3	2	2	1	4	2	4	
BREIDAMERKUR- JOKULL, ICELAND		1-2	3	3	2	2	N.A.	3-4	2	4	
LACROIX GLACIER ANTARCTIC		2	1	N.A.	3	2	3	3	2	4	
COWAL SCOTLAND		1	N.A.	3	N.A.	3	N.A.	4	4	2	
GLEN ORCHY SCOTLAND		1	1	2	2	4	1	5	4	2	

TABLE 6.7 APPARENT RELATIVE ABUNDANCES OF ELEMENTARY PARTICLE ARRANGEMENTS.

SOIL	CONNECTORS	INTERWEAVING BUNCHES	AGGREGATIONS		MATRICES	
			REGULAR	IRREGULAR	CLAY/GANULAR	GRANULAR
BLAISON, NORWEGIAN	1972	2	N.A.	2	N.A.	N.A.
	1965	N.A.	N.A.	1	N.A.	2
BREIDAMERKURJOKULL ICELAND	1	N.A.	3	1	2	3
LACROIX GLACIER ANTARCTICA	1	N.A.	3	N.A.	2	4
COWAL, SCOTLAND	N.A.	N.A.	N.A.	N.A.	N.A.	4
GLEN ORCHY, SCOTLAND	2	N.A.	3	3	N.A.	4

TABLE 6.8 APPARENT RELATIVE ABUNDANCES OF THE BASIC LEVEL OF PARTICLE ASSEMBLAGES.

TABLE 6.10. SOIL PROPERTIES OF TILL VIEWED IN ELECTRON MICROSCOPE.

SITE	ANTARCTICA	LAGLINGARTEN	GLEN ORCHY
LIQUID LIMIT (%)	27	27	17
PLASTIC LIMIT (%)	11	25	15
WATER CONTENT (%)	-	13-60	6-18
DRY DENSITY ( $t/m^3$ )	2.26	1.0-2.01	-
SPECIFIC GRAVITY	2.71	2.68	2.70
Rock Constituents	Granite Gneiss Sandstone Dolomite	Mica Schists Quartzite Limestone	Quartzite Granite Schist

TABLE 7.1. SPECIFIC GRAVITIES OF MATERIALS TESTED.

Origin of Material	Specific Gravity of Fines	Specific Gravity of Coarse
Laglingarten	2.65	2.71
Strathyre	2.66	2.71
Corrour	2.58	2.64

TABLE 7.2. PROPOSED LIMITS OF PARTICLE-SIZE DISTRIBUTION FOR BASES AND SURFACINGS, WITH TOLERANCES.

B.S. Sieve Size	Percentage passing					
	Base			Surfac-	Base or Surfacing	
	Nominal maximum size			Nom.max. size	Nominal maximum size	
3-in.	3-in.	1 $\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{3}{4}$ -in.	$\frac{5}{8}$ in.	$\frac{5}{16}$ in.
3 in.	100	-	-	-	-	-
1 $\frac{1}{2}$ in.	80 - 100	100	-	-	-	-
$\frac{3}{4}$ in.	60 - 80	80 - 100	100	100	-	-
$\frac{5}{8}$ in.	45 - 65	55 - 80	80 - 100	80 - 100	100	-
$\frac{5}{16}$ in.	30 - 50	40 - 60	50 - 75	60 - 85	80 - 100	100
No. 7	-	30 - 50	35 - 60	45 - 70	50 - 80	80 - 100
No. 14	-	-	-	35 - 60	40 - 65	50 - 80
No. 25	10 - 30	15 - 30	15 - 35	-	-	30 - 60
No. 52.	-	-	-	20 - 40	20 - 40	20 - 45
No. 200	5 - 15	5 - 15	5 - 15	10 - 25	10 - 25	10 - 25

#### Notes

1. Not less than 10 per cent should be retained between each pair of successive sieves specified for use, excepting the largest pair.
2. The two smaller sized materials ( $\frac{5}{8}$  and  $\frac{5}{16}$ in.) may have up to 35 per cent of stones not larger than 1 $\frac{1}{2}$ -in., provided that the material passing the  $\frac{5}{16}$ in. sieve is within the limits specified.
3. The material passing the No. 36 sieve shall have the following characteristics (B.S. 1377: 1967);-

TABLE 7.2. (contd.)

for basis	Liquid limit not exceeding 25 per cent. Plasticity index not exceeding 6 per cent.
For surfacings	Liquid limit not exceeding 35 per cent. Plasticity index between 4 and 8 per cent.

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TABLE 7.3. RANGE OF NATURAL WATER CONTENTS IN TILLS TESTED

Site	Water Content of < 20 mm ( $\frac{3}{4}$ "') Material		
	Minimum	Average	Maximum
Laglingarten	13.4	37.0	59.7
Corrour Forest	3.40	8.40	15.0
Strathyre	7.6	25.9	54.0

**TABLE 7.4 RELATIONSHIP BETWEEN PROCTOR OPTIMUM WATER CONTENT AND WATER CONTENT AT  
MINIMUM PERMEABILITY FOR NORWEGIAN DAMS.**

DAM*	PROCTOR OPTIMUM WATER CONTENT (%)	WATER CONTENT AT MINIMUM PERMEABILITY (%)	DIFFERENCE IN WATER CONTENT (%)
AKERSVATN	8.5	10.0	+1.5
KALVATN	9.3	11.0	+1.7
VASSLIVATN	7.2	9.4	+2.2
FOLLSJØ	7.1	9.2	+2.1
MANNDOLA	7.0	8.0	+1.0
DRAVALADALSVATN	9.2	11.2	+2.0
VATNA	8.5	8.5	0
MYSEVATN	7.5	8.7	+1.2
JUKLAVATN	7.5	7.8	+0.3
STØLSVATN	7.2	8.5	+1.3

\* TYPICAL GRADINGS DETAILED IN CHAPTER 5 WERE USED IN THESE TESTS  
WITH A MAXIMUM PARTICLE SIZE LIMIT OF 20 mm DIAMETER.

TABLE 7.5. PERMEABILITY VALUES IN MONTREAL TILLS.

Soils Tested	Number of Tests	Coefficient of Permeability (cm/sec)	
		Average	Range
Undisturbed Laboratory Specimen	30	$2.8 \times 10^{-2}$	$3 \times 10^{-1}$ to $1 \times 10^{-3}$
Remoulded Laboratory Specimen	25	-	$10$ to $10^{-3}$
In-situ Undisturbed Permeability Test	7	$3 \times 10^{-1}$	$5 \times 10^{-1}$ to $9 \times 10^{-3}$
Recompacted Till In-situ Test	32	$1.5 \times 10^{-6}$	$3 \times 10^{-4}$ to $1 \times 10^{-7}$

TABLE 7.6. SOURCE AND PROPERTIES OF KOERNER'S (1970a) SOIL.

Source	$d_{10}$ (mm)	Hazen's Uniformity Coefficient	Min. Density (t/m <sup>3</sup> )	Max. Density (t/m <sup>3</sup> )	Angularity	Sphericity
Crushed massive milky quartz	0.25	1.25	1.18	1.57	Angular	0.45
Crushed Ottawa Sand	0.25	1.25	1.38	1.66	Sub-Angular	0.58
Fines of Ottawa Sand	0.25	1.25	1.47	1.73	Sub-Rounded	0.67

**FIGURES**

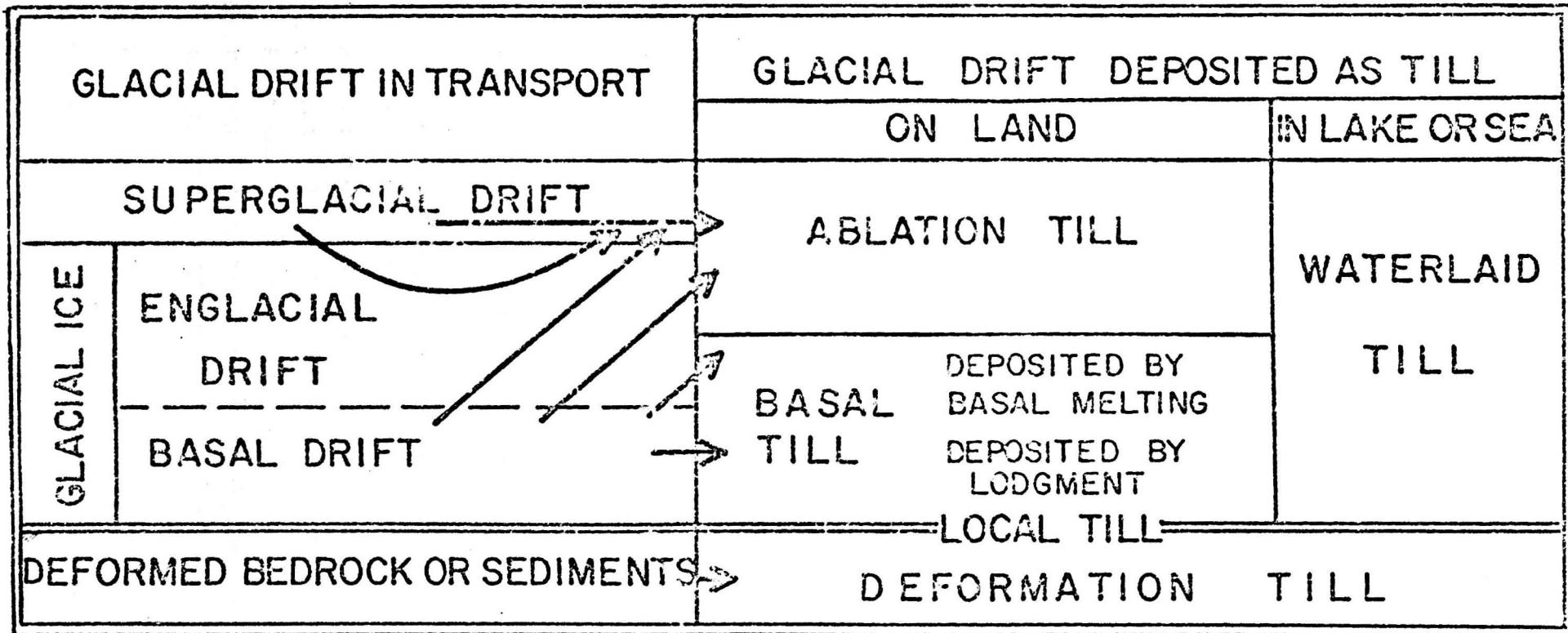


FIG. 2.1. CLASSIFICATION OF TILLS AND GLACIAL DRIFT IN TRANSPORT (DREIMANIS AND VAGNER 1971).

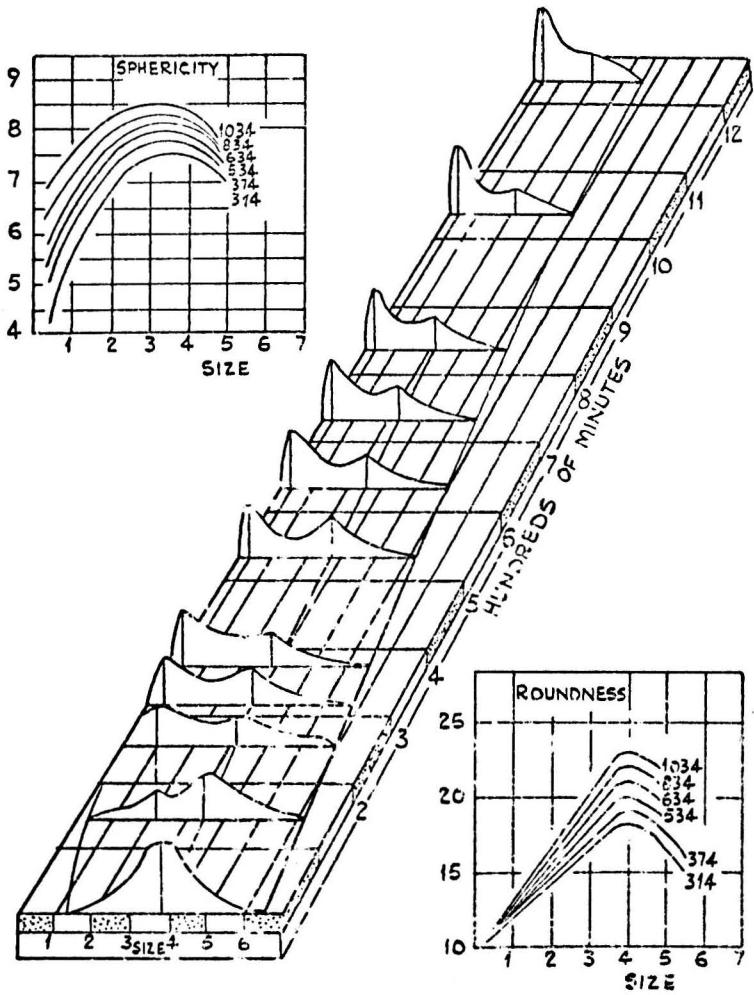


FIG. 3-1. GRAIN ANALYSES OF MINERALS IN BALL MILLS, MICROLINE

CENTRAL FIGURE: FREQUENCY-DISTRIBUTION CURVES, PER CENT BY NUMBER OF GRAINS PLOTTED AGAINST SIZE, MM, AS NOMINAL SECTIONAL DIAMETER, FOR NUMBER OF MIN ROTATED DRY IN BALL MILL.

UPPER LEFT: SPHERICITY, BASED UPON PATTERNS OF RITTENHOUSE, AND PLOTTED FROM SCATTER DIAGRAMS. NUMBERS REFER TO LENGTH OF TIME ROTATED.

LOWER RIGHT: ROUNDNESS, BASED UPON PATTERNS OF KRUMBEIN. NUMBERS REFER TO LENGTH OF TIME ROTATED.

(AFTER ALLING, 1944)

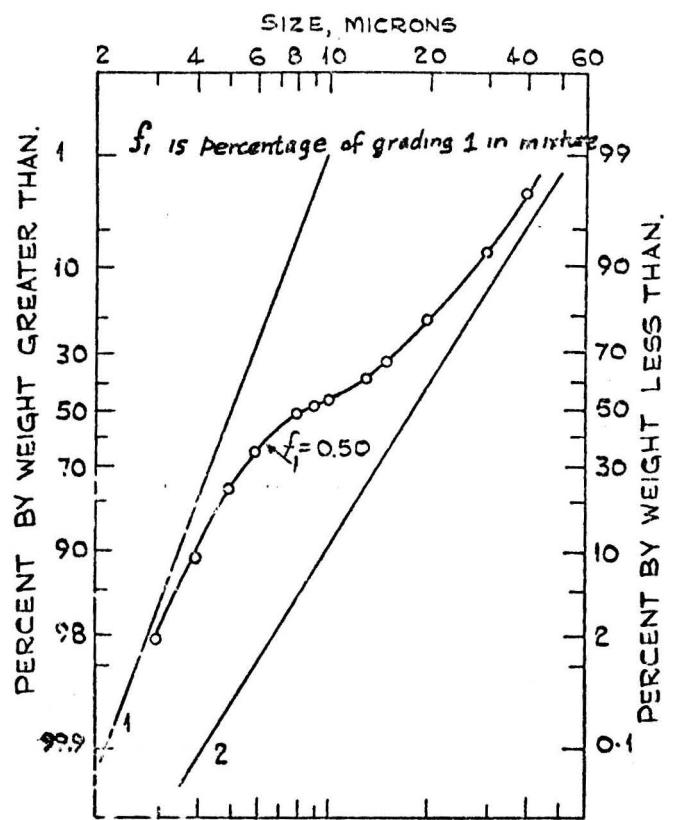


FIG. 3.2. HETEROGENEOUS DISTRIBUTION. (IRANI AND CALLIS 1963)

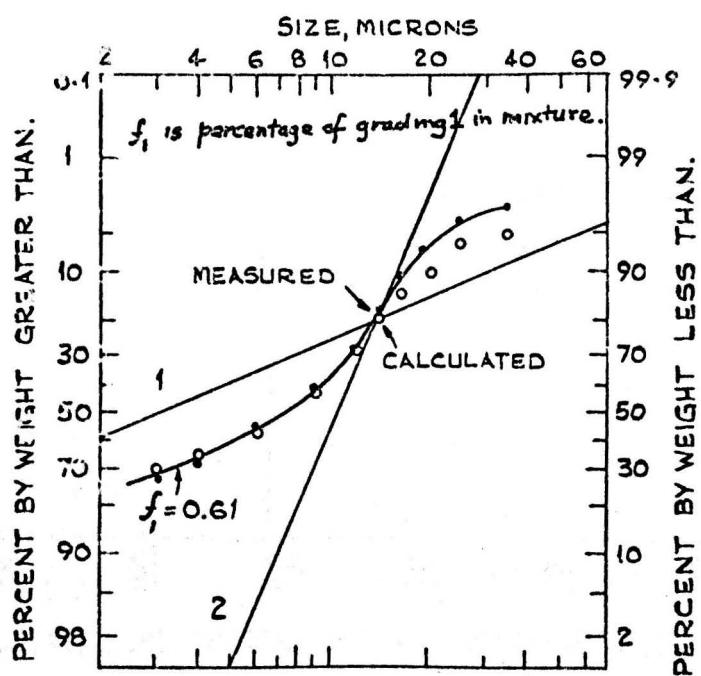
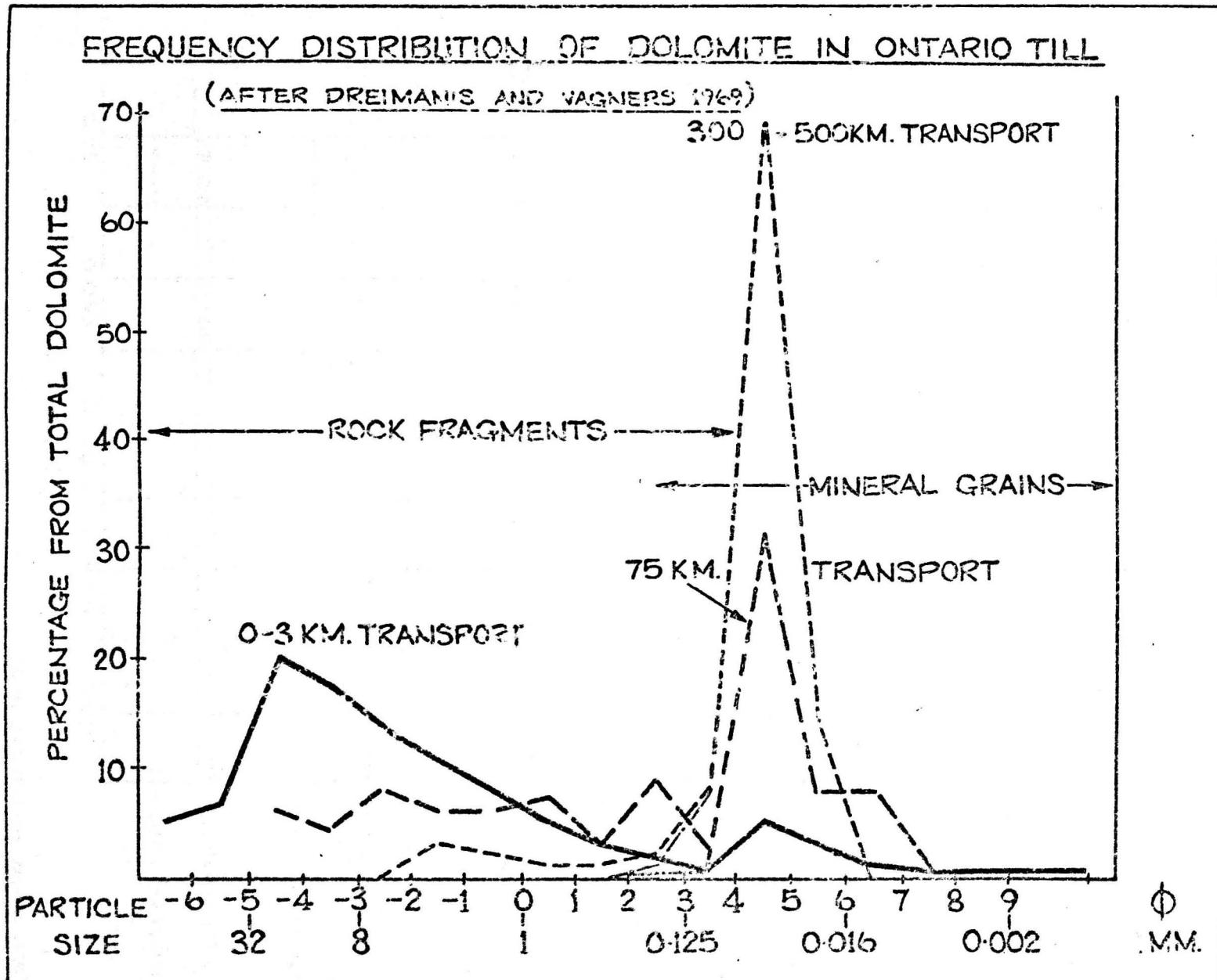


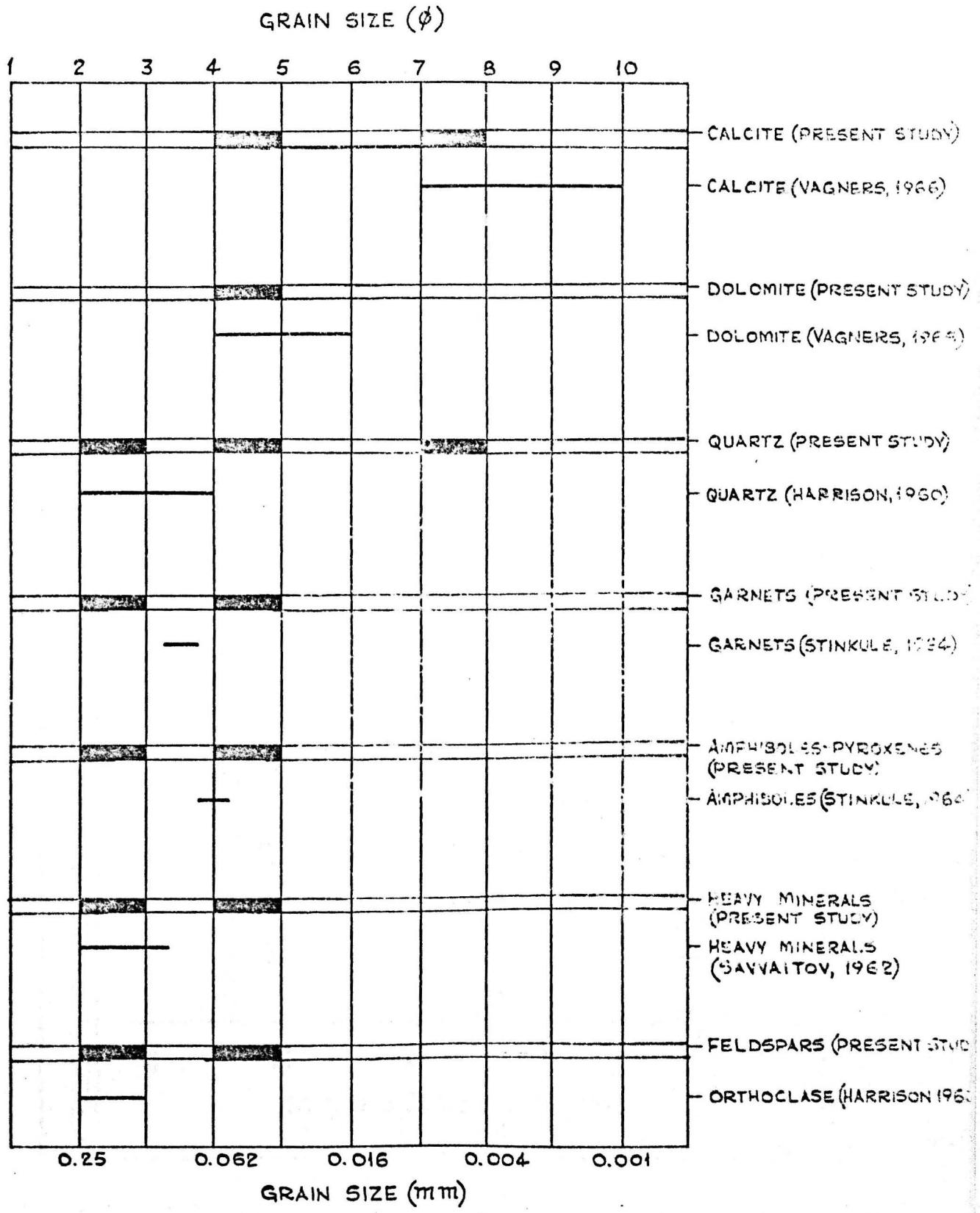
FIG. 3.3. HETEROGENEOUS DISTRIBUTIONS (IRANI AND CALLIS 1963).

FIG. 3.4.



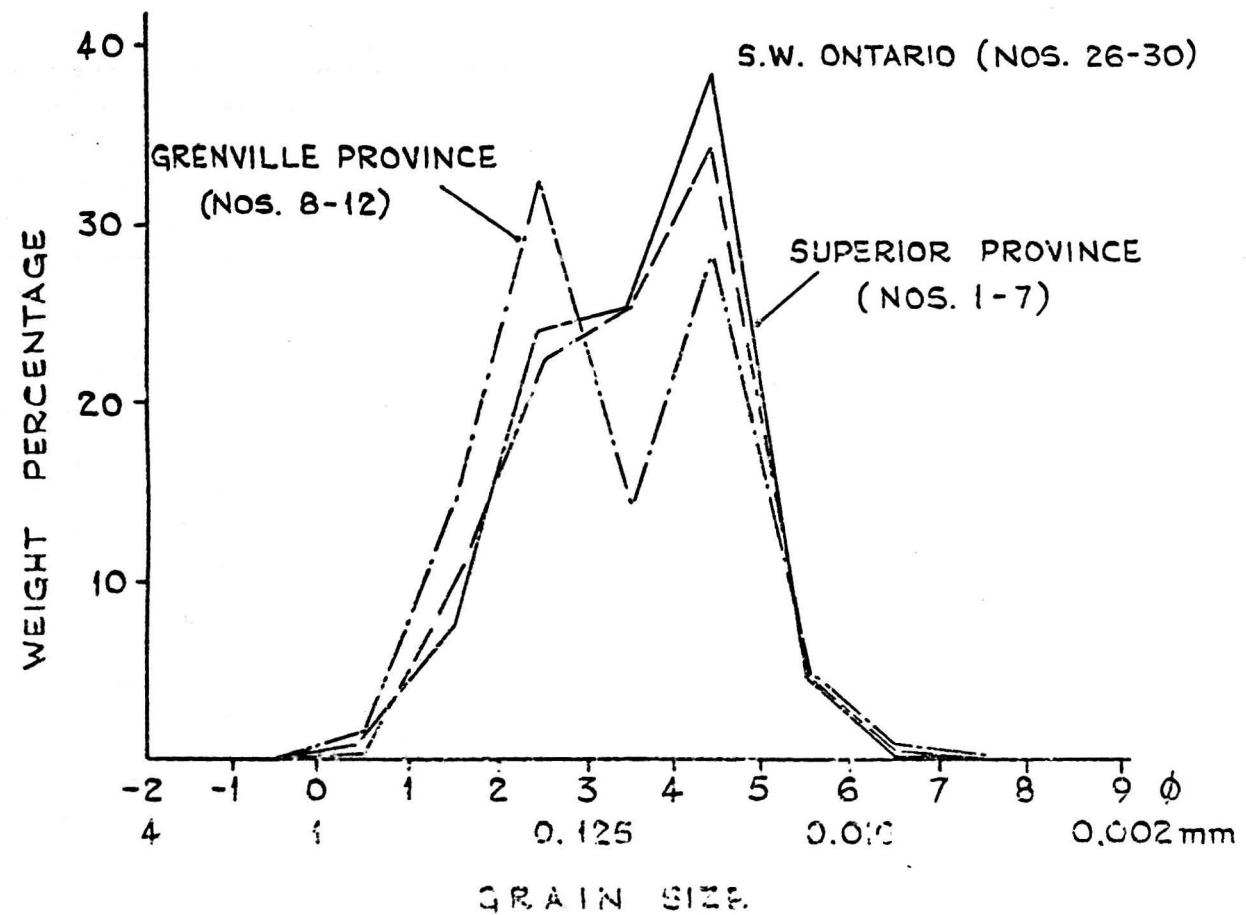
Note:  $\phi$  is  $-\log_2$  of the diameter in mm.

FIG. 3.5. TERMINAL MODES IN BASAL TILL



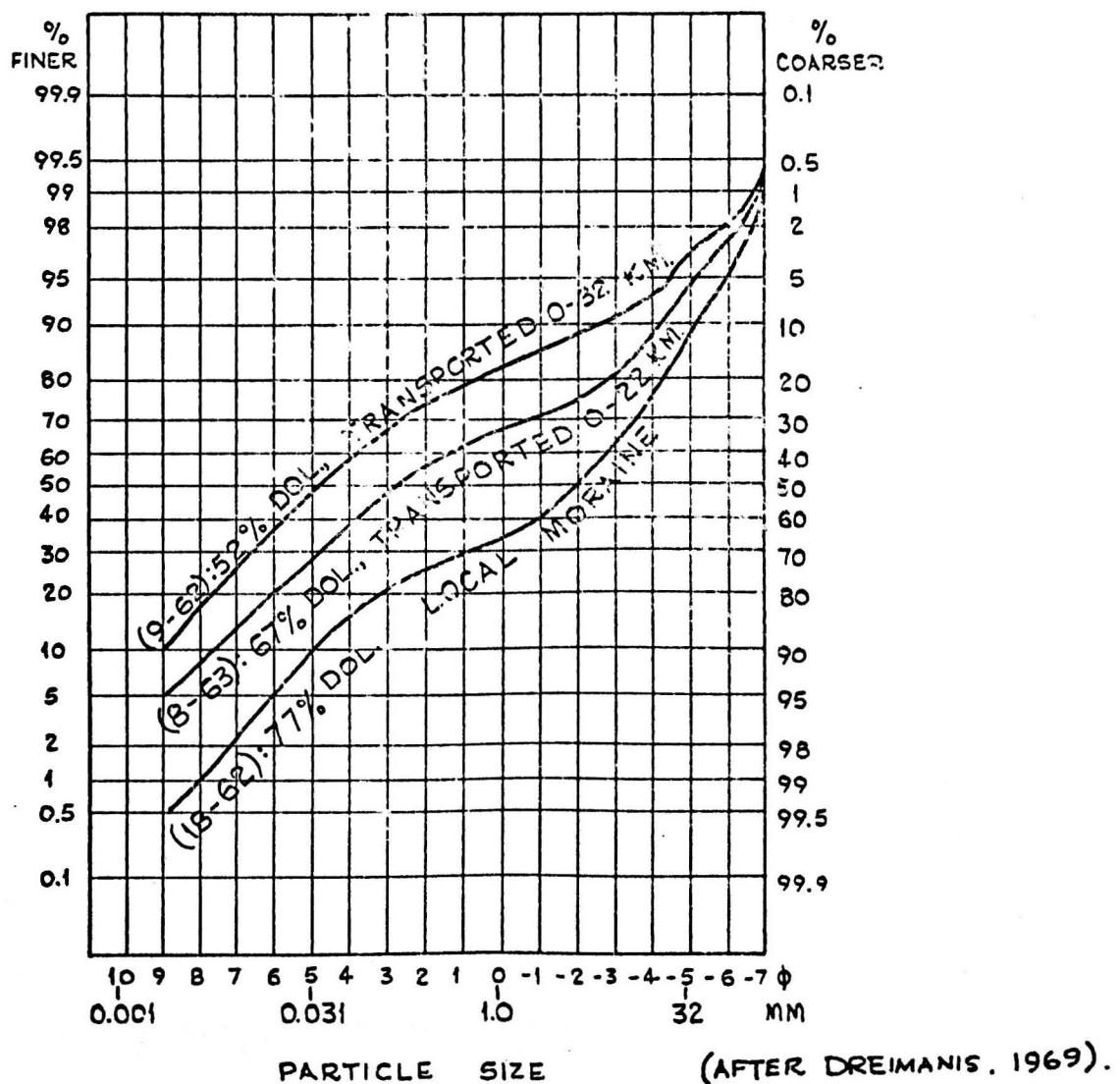
(AFTER DREIMANIS AND VAGNERS 1969.)

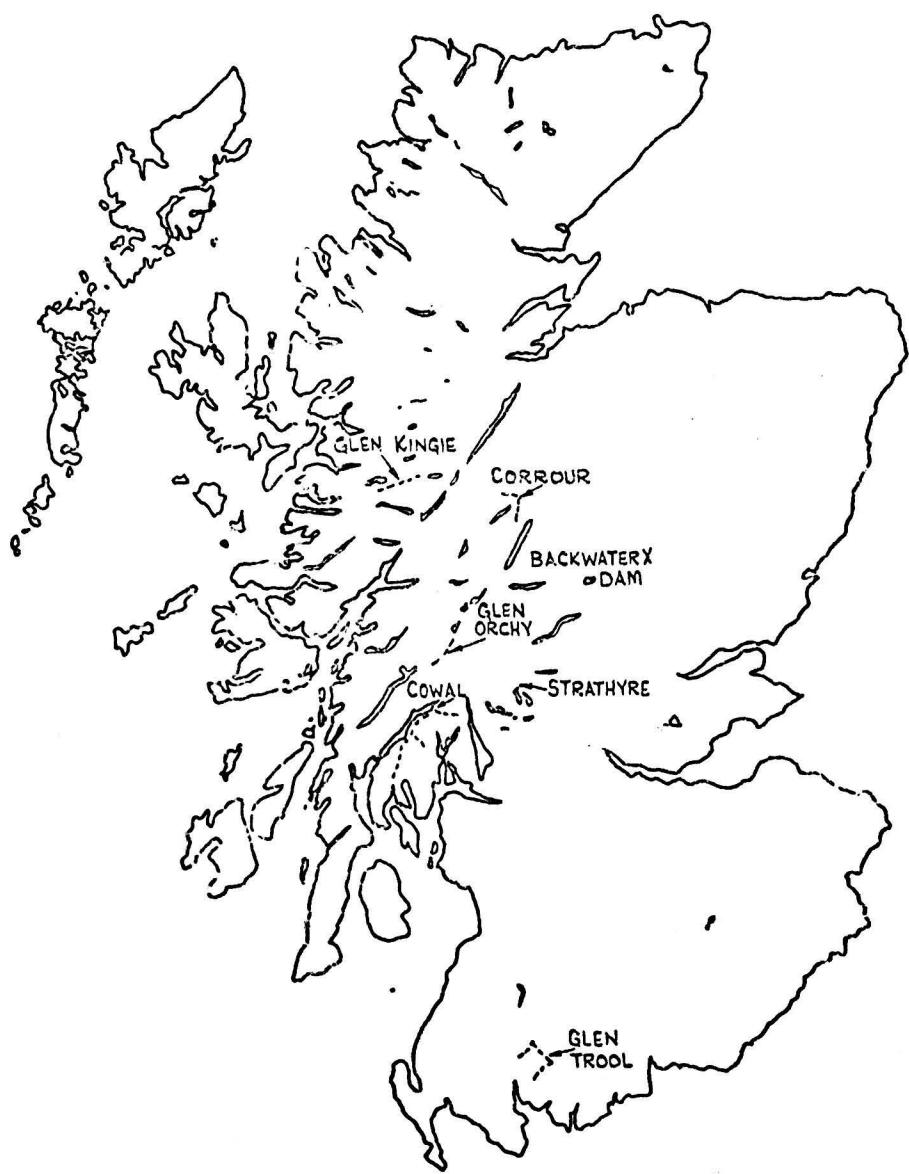
FIG. 3.6. GARNET DISTRIBUTION IN TILLS OF ONTARIO



(AFTER DEIMANIS AND VAGNER'S 1971)

FIG. 3.7. DOLOMITIC TILLS OF S.W. ONTARIO  
CANADA.





SCOTTISH SITES STUDIED.

FIG. 4.1.

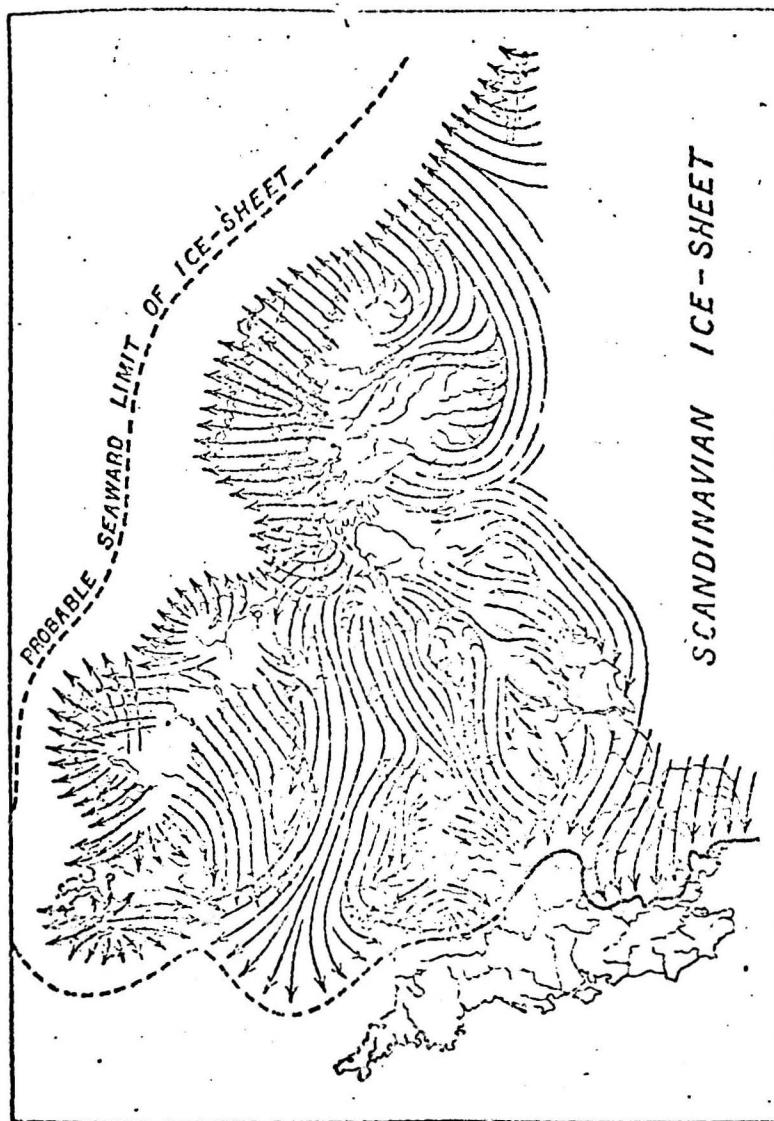


FIG. 4.2. MAP SHOWING LINES OF ICE FLOW  
AND THE LIMITS OF GLACIATION IN THE  
BRITISH ISLES (WRIGHT 1937).

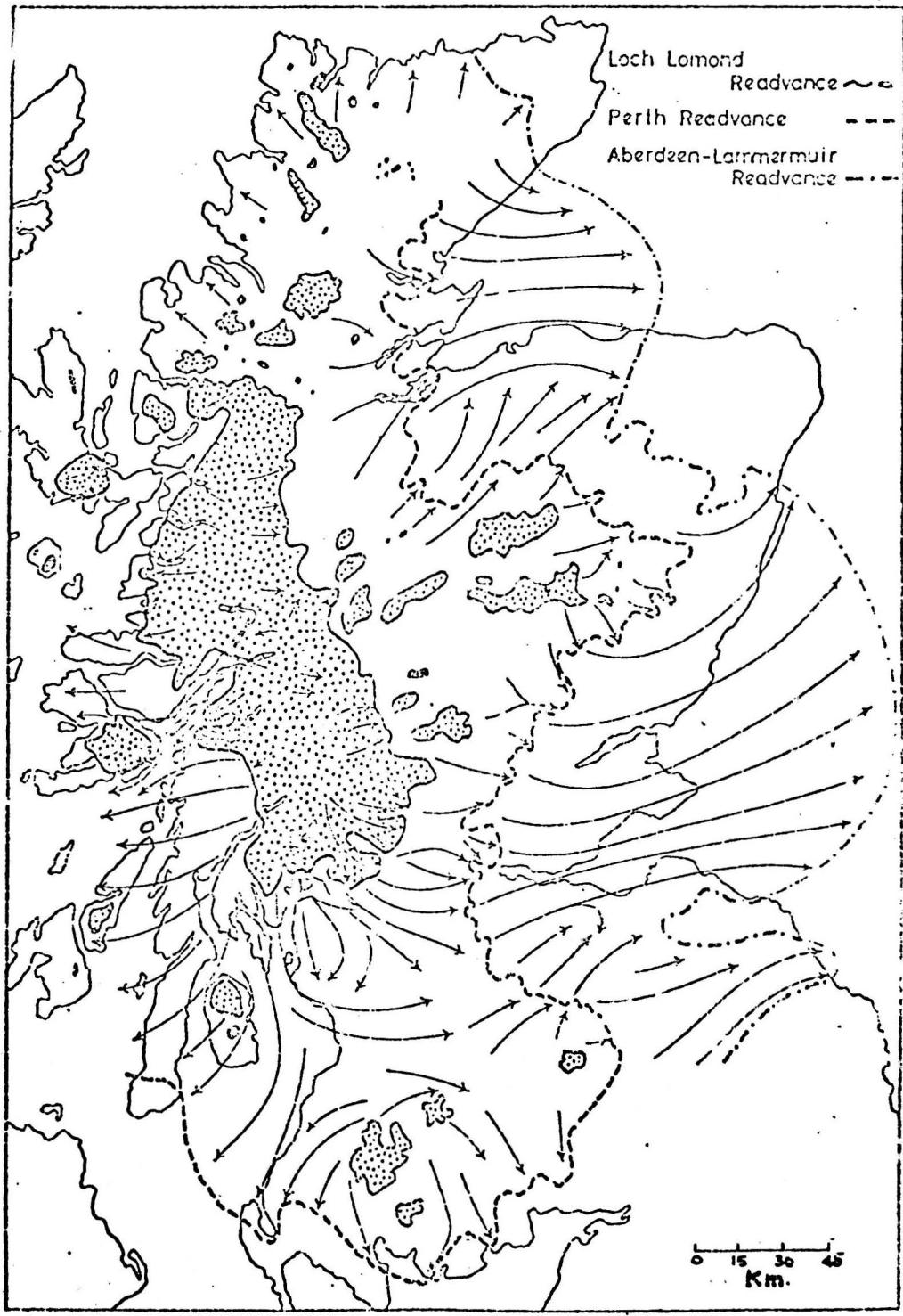


FIG. 4.3

Map showing Limits of Glacial Readvance  
(Sissons, 1967)

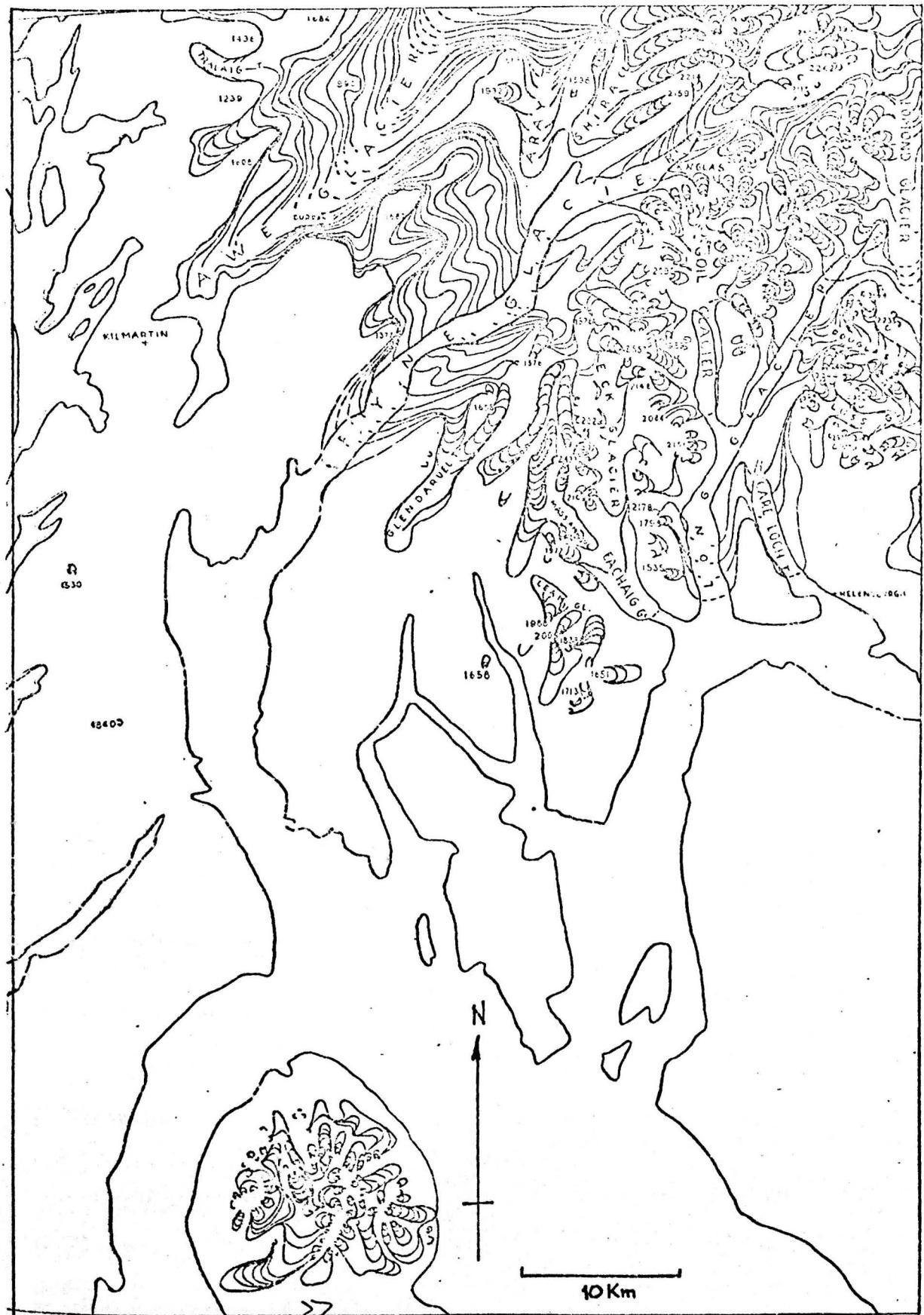
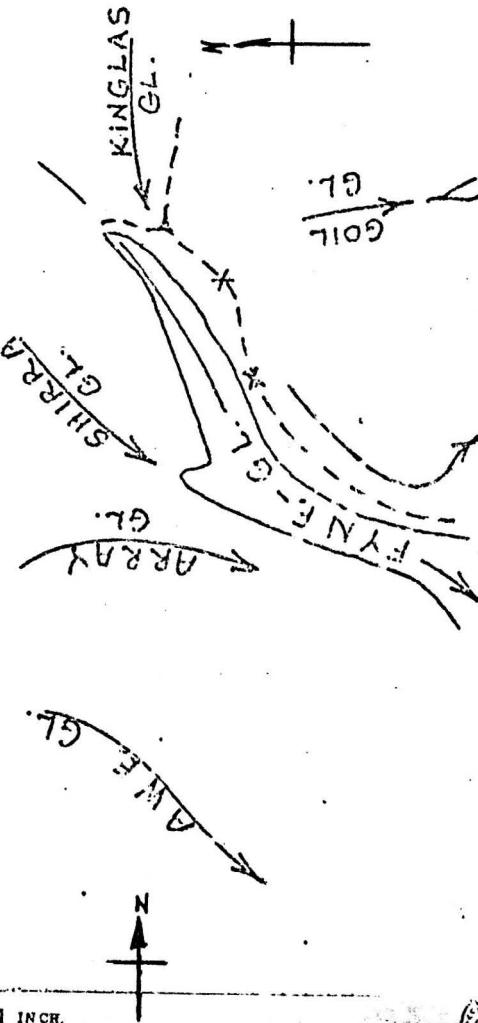


FIG. 4.4. GLACIAL MARGINS OF AWE, FYNE AND LONG GLACIERS.

(CHARLESWORTH 1956)

### LAGLINGARTEN

Note:- Samples have been taken from the location indicated on the plan opposite and have been compared with other samples taken from various sections of roadwork along the A815.



Sketch Map showing direction of Glaciers  
(not to scale)

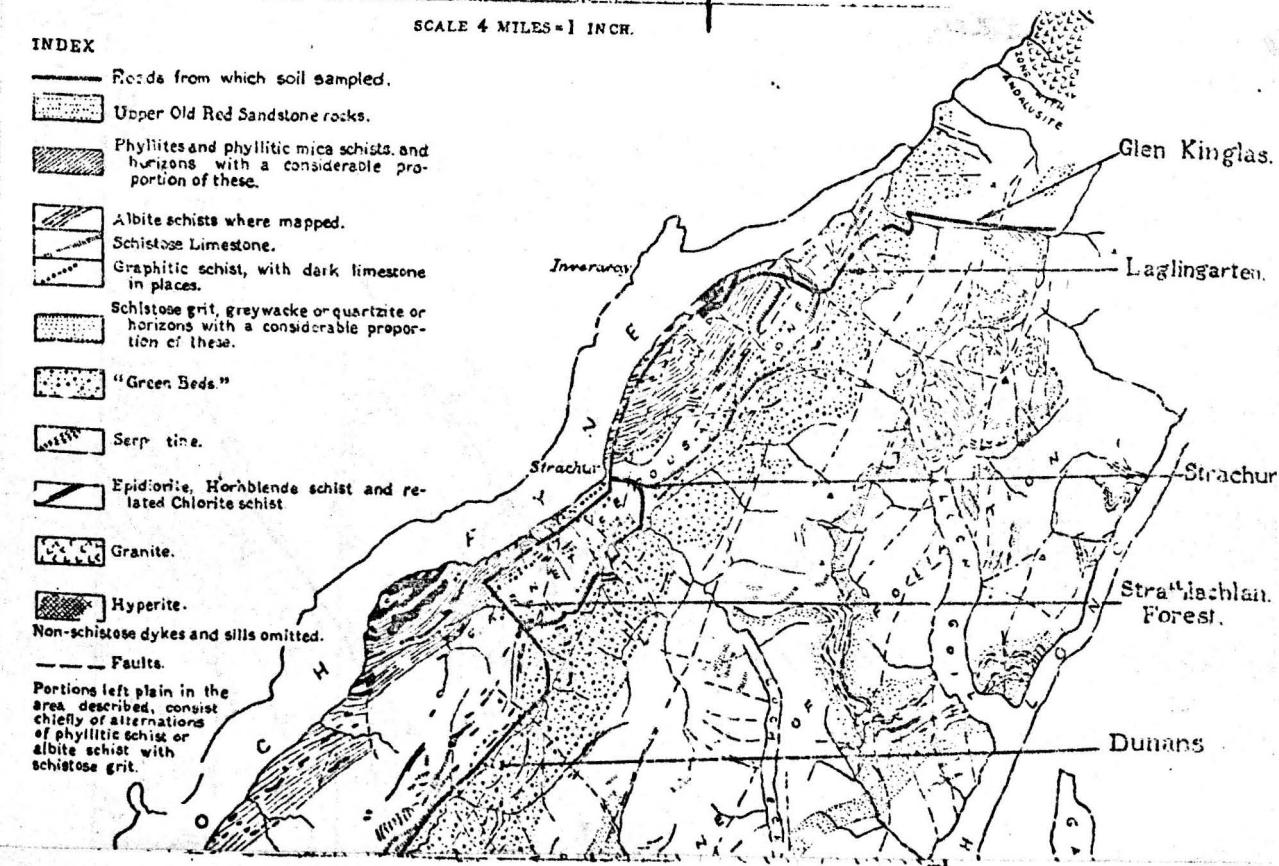
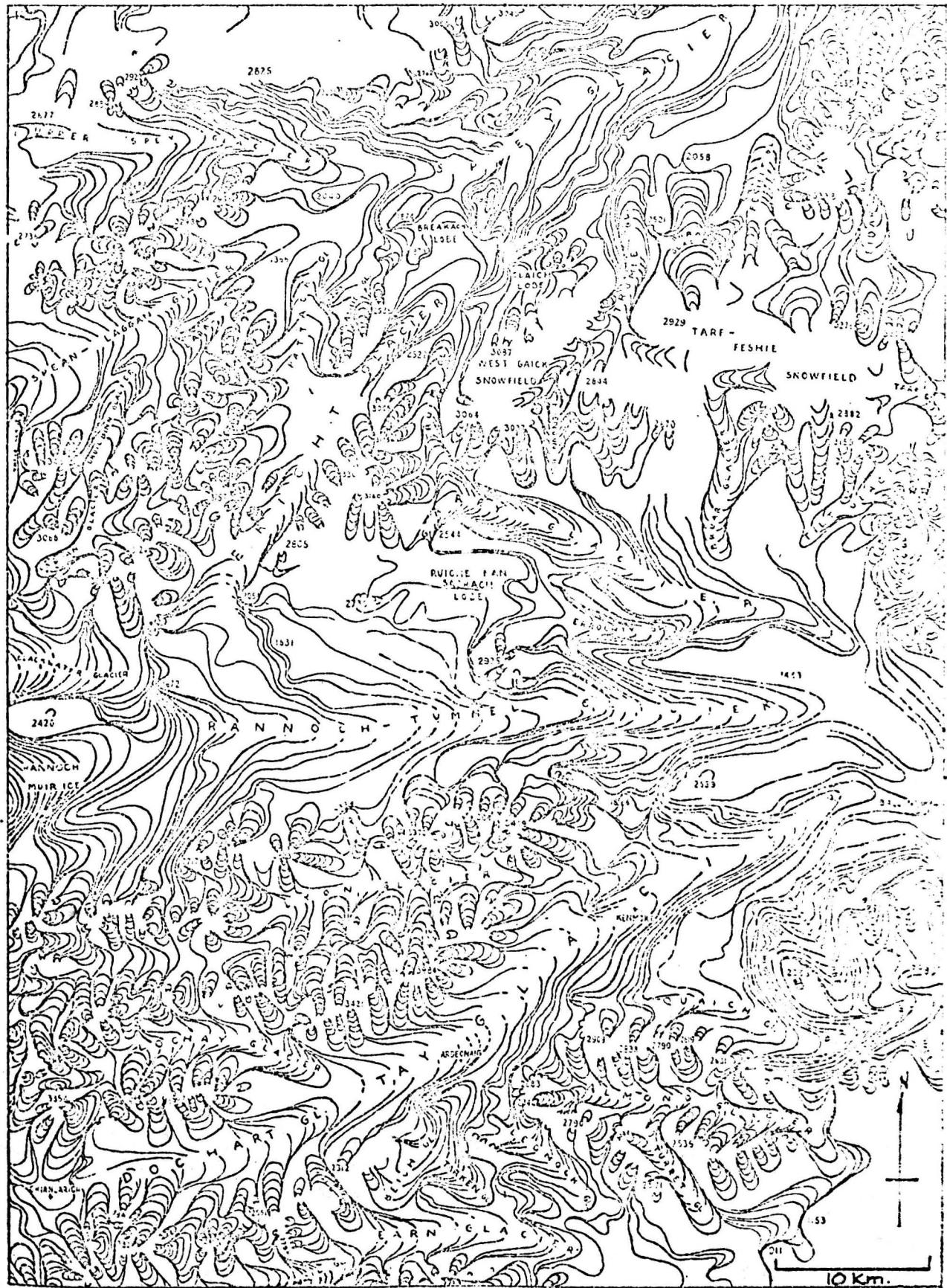
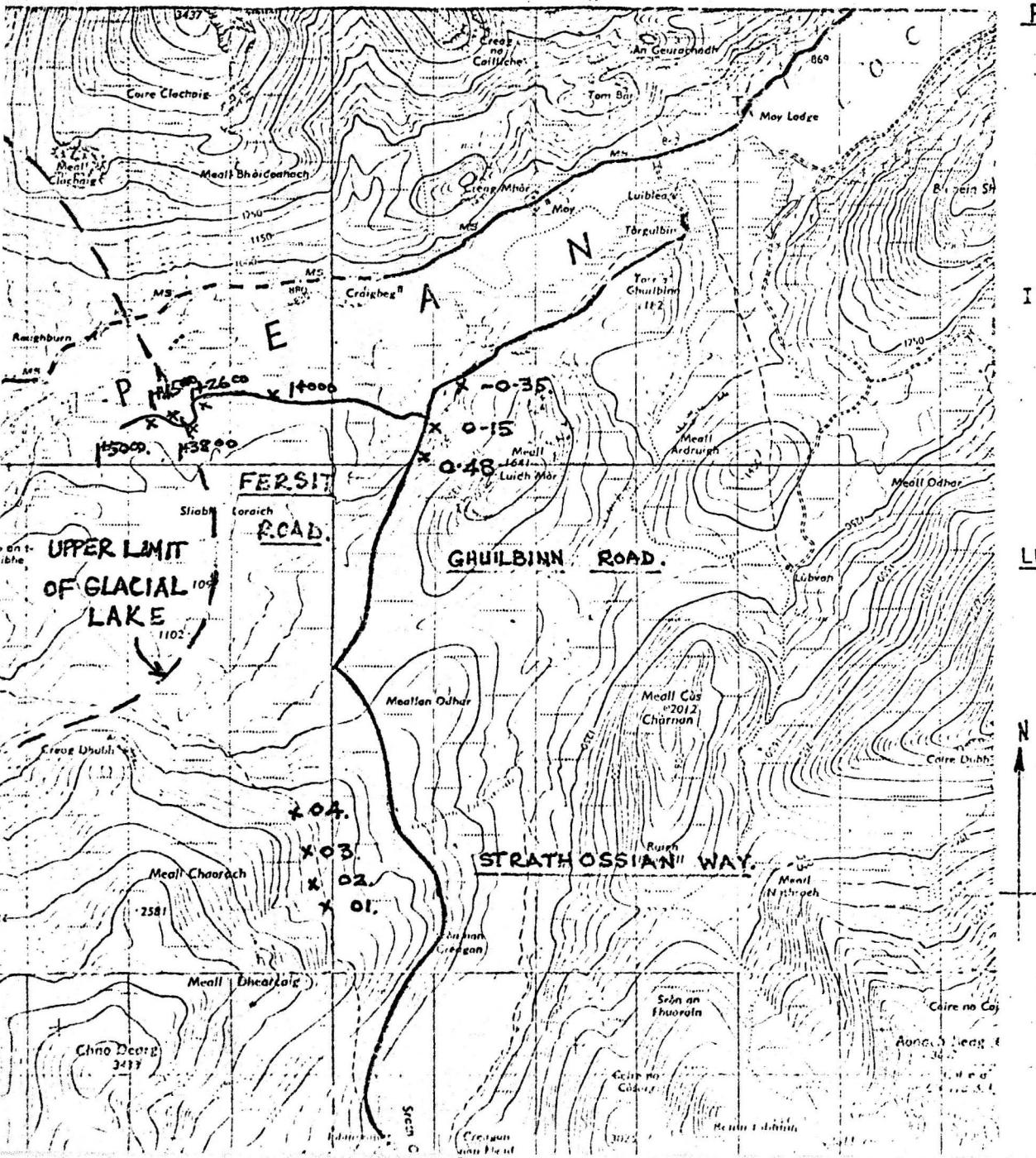


FIG. 4.5. SAMPLE LOCATIONS AND GLACIAL DIRECTIONS AT LAGLINGARTEN.





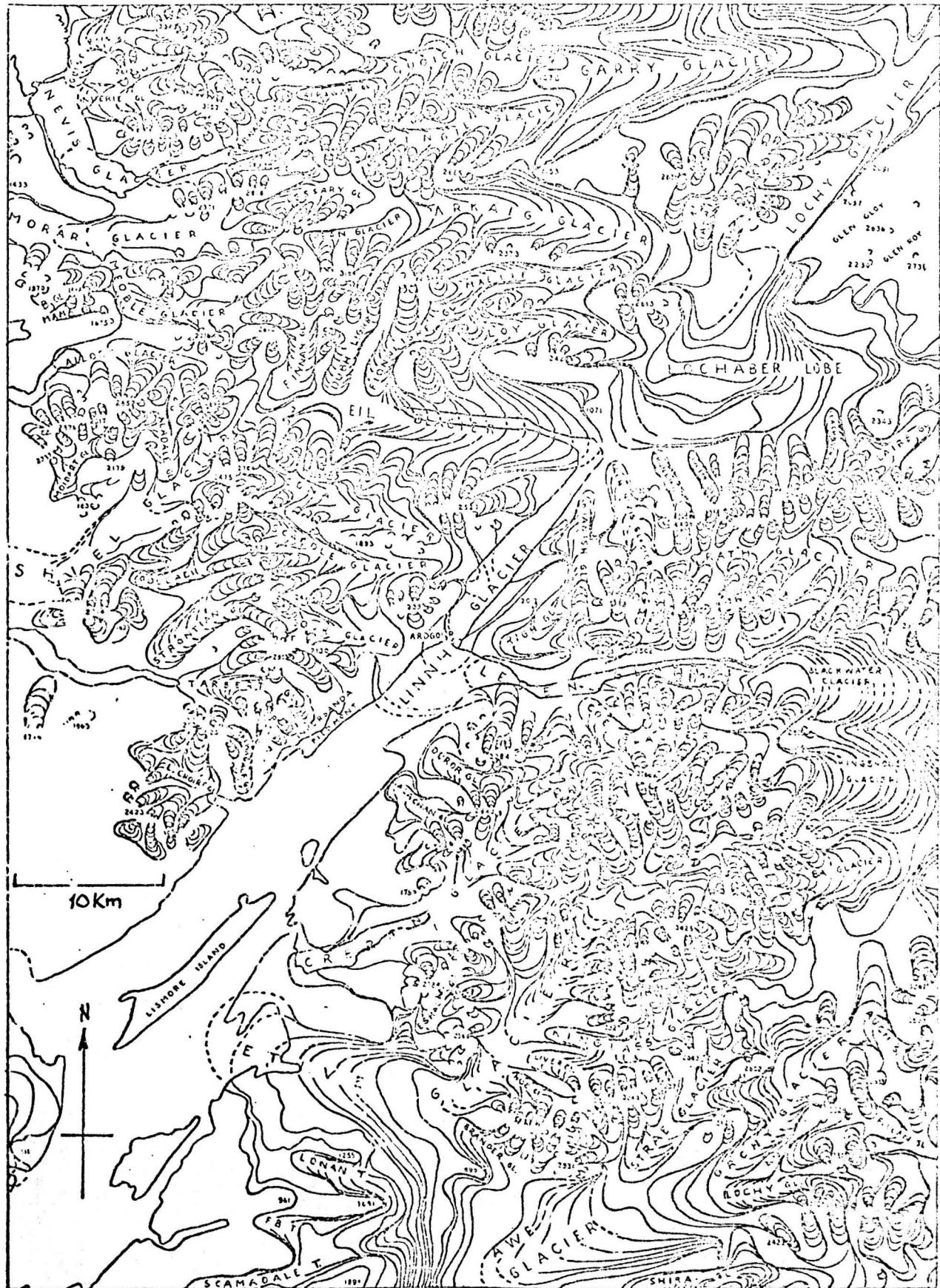
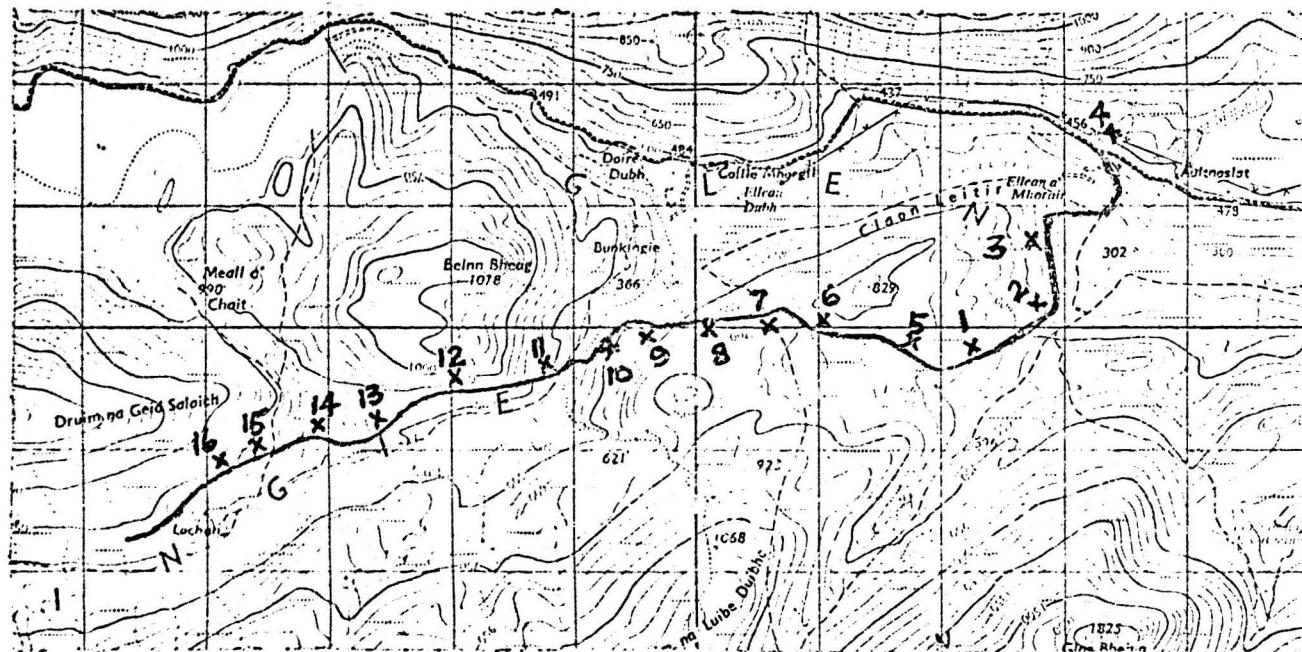


FIG 4.8 MARGINS OF ICE IN SOUTH WEST HIGHLANDS

(CHARLESWORTH 1956).



### GLEN GARRY FOREST

### KINGIE, POULARY, AND GREENFIELD FARM

Note:- Samples have been taken at half mile intervals along the line of the proposed road.

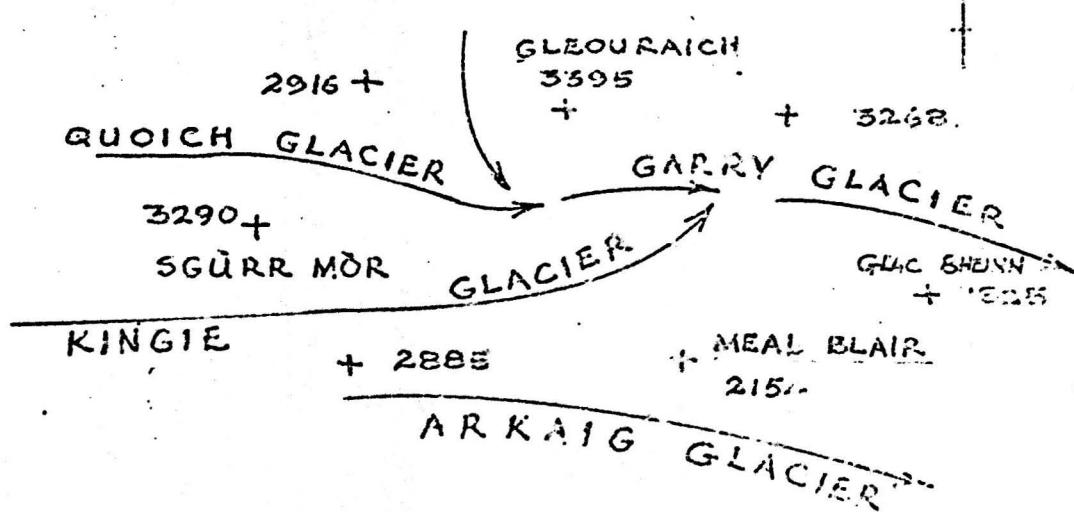
The locations of the sampling points are shown on the map opposite.

LOCATION PLAN 1": 1<sup>mi</sup>.

FIG. 4.9.

SAMPLE LOCATIONS AND GLACIATION DIRECTIONS  
AT GLEN KINGIE.

SKETCH MAP SHOWING THE DIRECTION  
OF THE GLACIERS  
(not to scale)



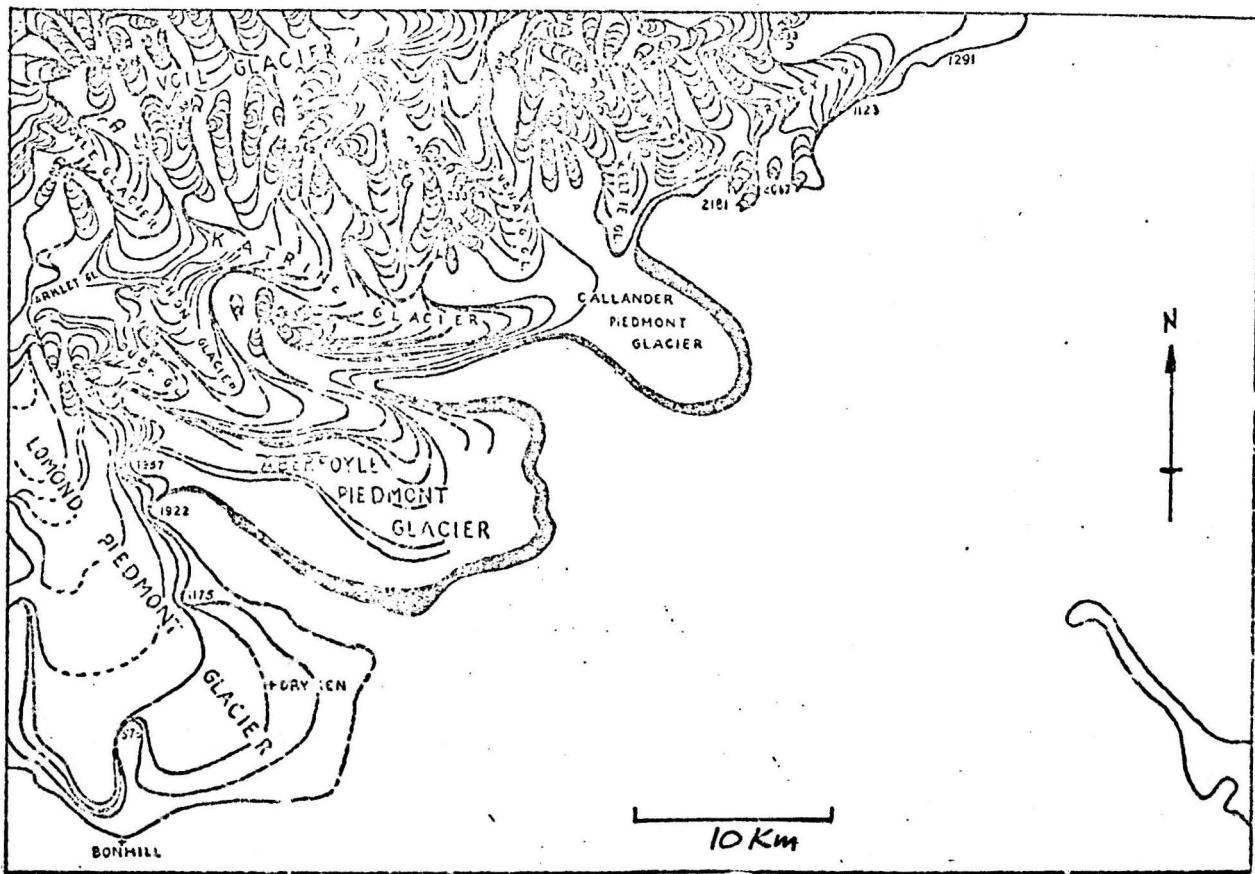
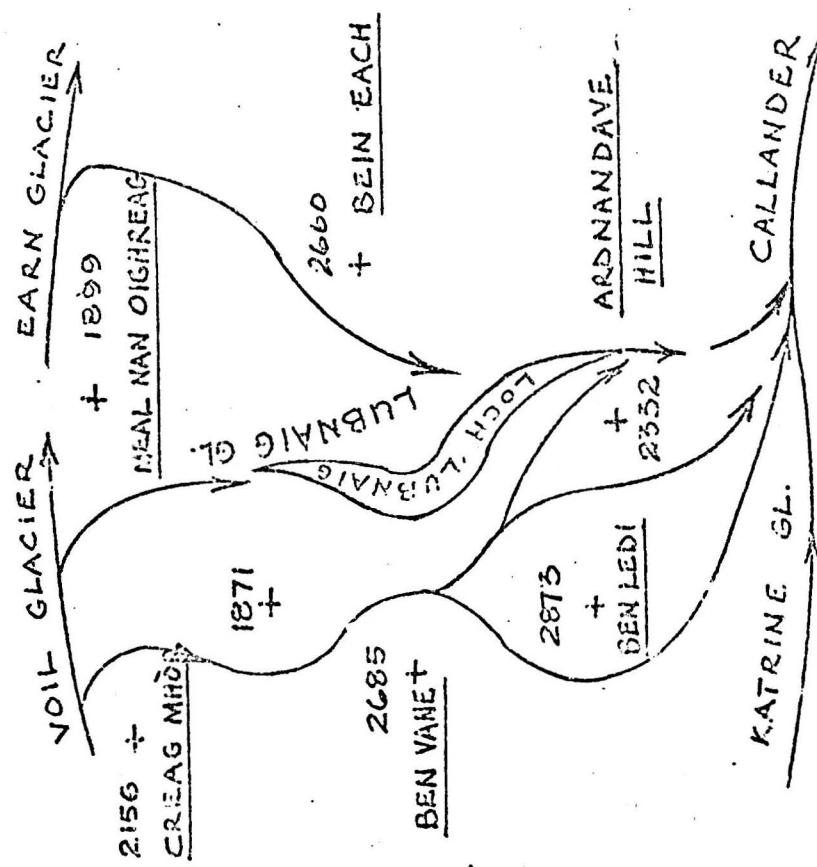
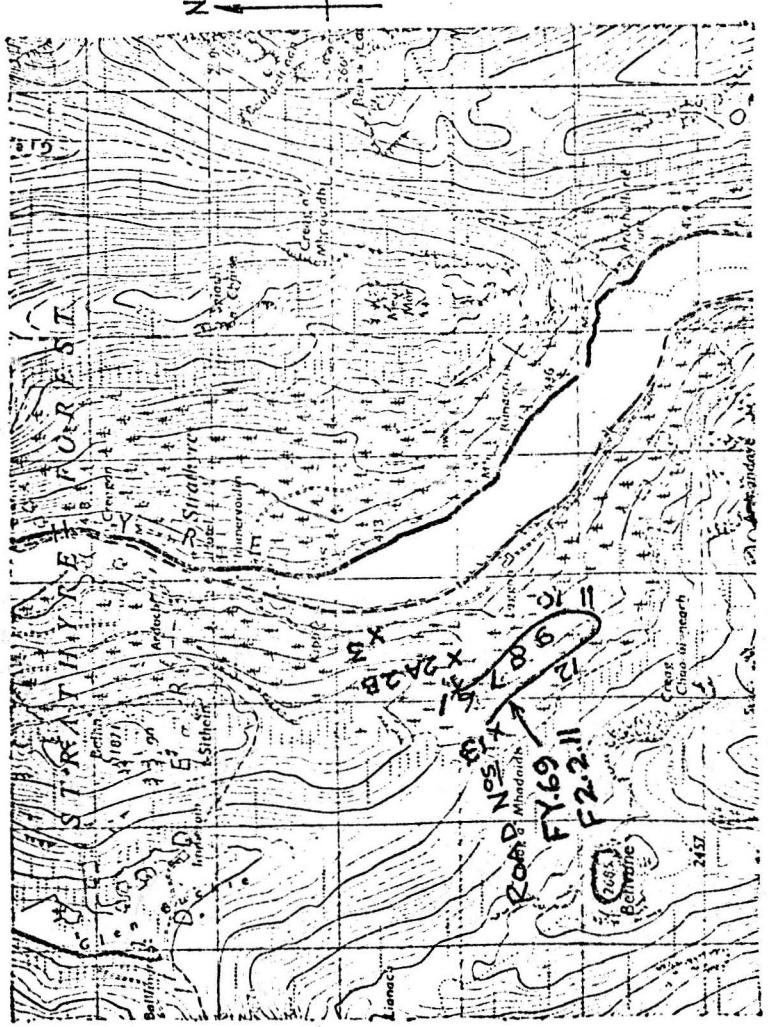


FIG. 4.10 MARGINS OF LOMOND ABERFOYLE AND CALLANDER GLACIERS.

(CHARLESWORTH 1956 ).



STRATHYRE FOREST  
Note:- Samples have been taken at 300m intervals and have  
 been related to Forestry Commission chaining pegs.

LOCATION PLAN 1" : 1mi.

SKETCH MAP SHOWING DIRECTION OF GLACIERS  
 (not to scale).

FIG. 4.II. SAMPLE LOCATIONS AND GLACIATION DIRECTIONS AT STRATHYRE FOREST.

KETCH MAP  
FLOWING DIRECTION  
GLACIERS

(not to  
scale)

AWE  
GLACIER

STRAE GLACIER

BEINN MHIC MHONAIDH

+ 2602

2127 +

ORCHY

GLACIER

+ BEINN MA SPÒINE  
2085

3708

+ BEN LUI

LOCHY

GLACIER.

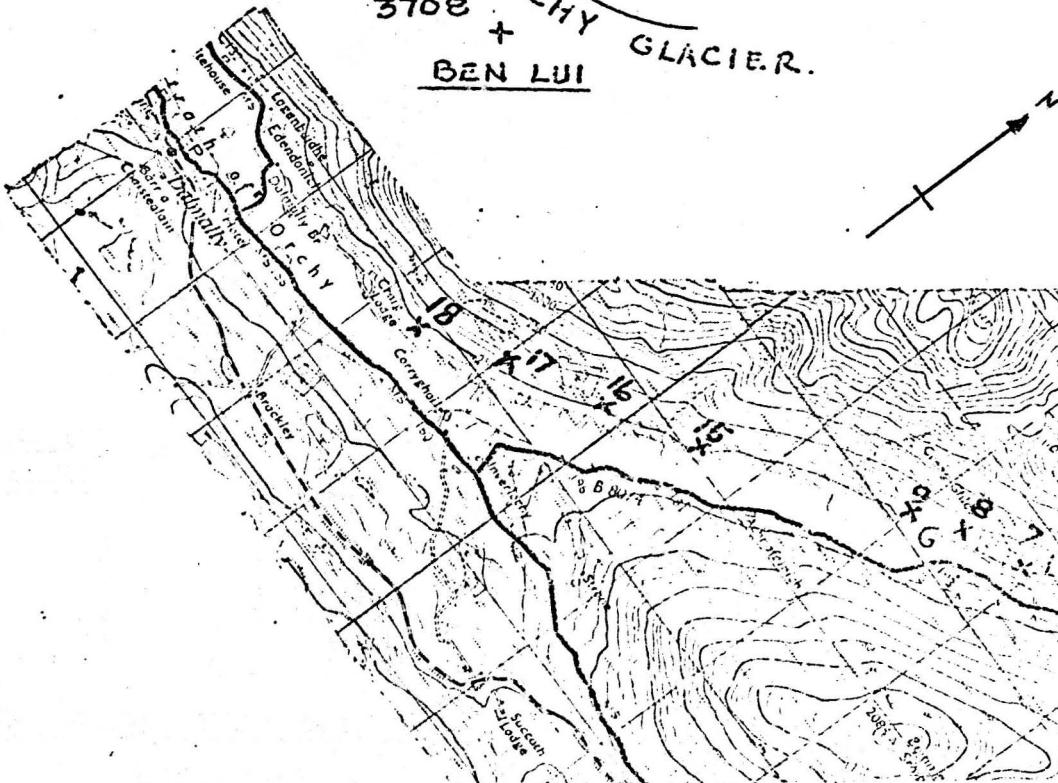


FIG. 4.12. SAMPLE LOCATIONS AND GLACIATION DIRECTIONS

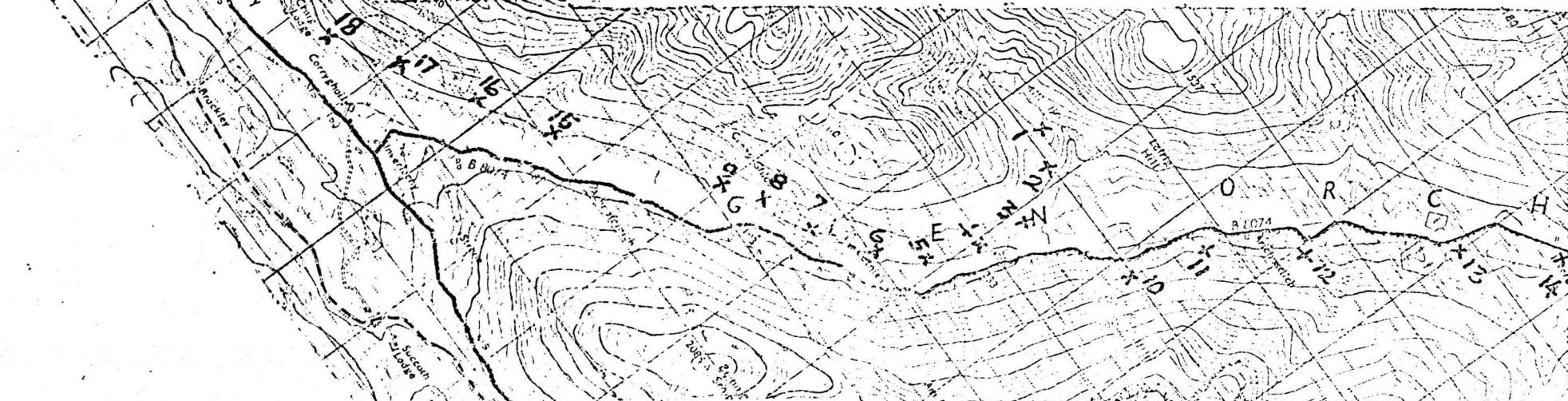
AT GLEN ORCHY FOREST.

GLEN ORCHY FOREST

Plan showing location of samples taken in  
Glen Orchy along the line of a proposed road

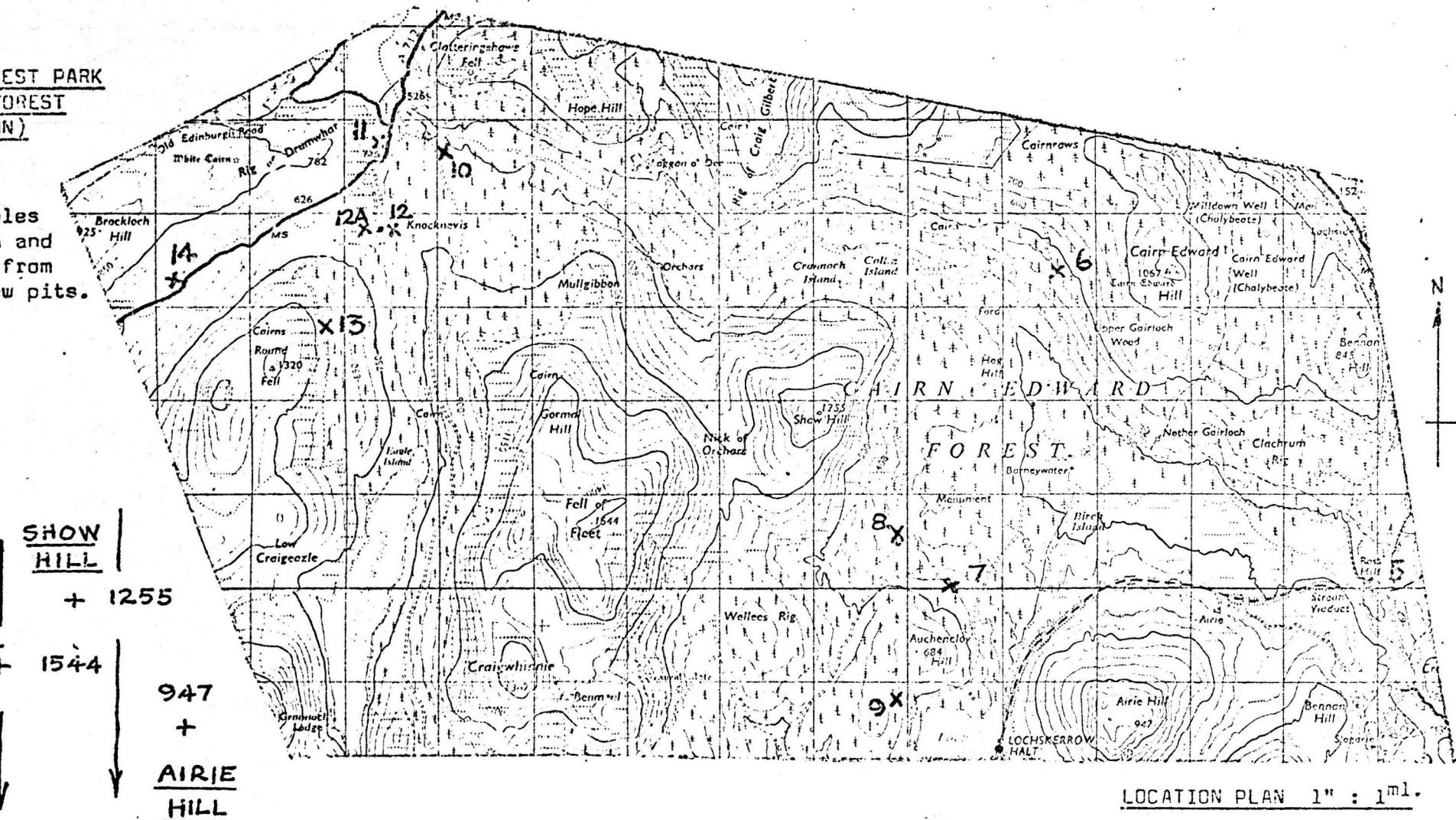
Due to the inaccessibility of the upper part  
of the Glen with regard to the extraction of  
samples 10, 11, 12, 13 and 14 have been taken  
on the eastern side of the River Orchy. These  
should be of similar nature to those which  
would have been obtained on the line of the  
proposed road.

LOCATION PLAN 1" : 1ml.



GLEN TROOL FOREST PARK  
CAIRN EDWARD FOREST  
(BENNAN SECTION)

Note:- All samples other than 12A and 13 were taken from existing borrow pits.



SKETCH MAP SHOWING DIRECTION OF GLACIERS

(not to scale)

FIG. 4.13. SAMPLE LOCATIONS AND GLACIATION DIRECTIONS  
 AT CAIRN EDWARD FOREST (BENNAN SECTION).



LOCATION PLAN 1" : 1ml.

GLEN TROOL FOREST PARK

GARCGOG FOREST

Note:- Samples No. 15 and 17 taken from existing borrow pits.

Sample No. 16 taken from trial pit in forest.

EARLAY

HILL

+  
651

ARVIE

HILL

+  
726

924

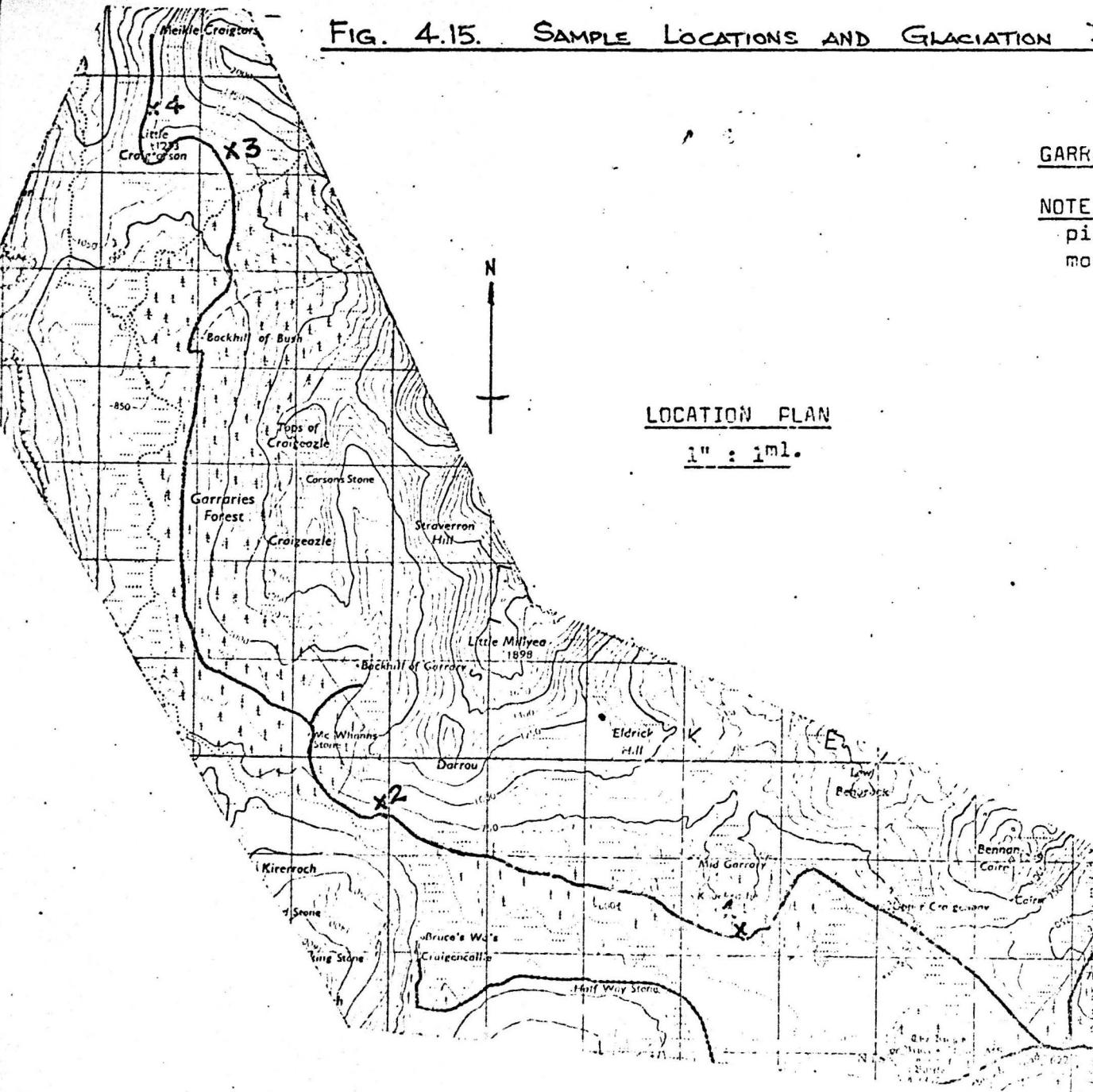
SKETCH MAP SHOWING THE DIRECTION OF THE GLACIER

(not to scale)

FIG. 4.14. SAMPLE LOCATIONS AND GLACIATION DIRECTIONS AT GARCROGO FOREST.

FIG. 4.15. SAMPLE LOCATIONS AND GLACIATION DIRECTIONS AT GARRARIES FOREST

GLEN TROOL FOREST PARK



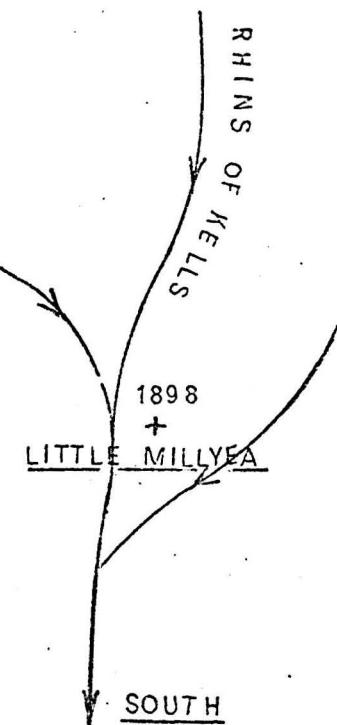
GARRARIES FOREST

NOTE:- Samples 1, 2 and 3 taken from borrow pits, sample No. 4 from cutting in sheet moraine.

BLACK GAIRY

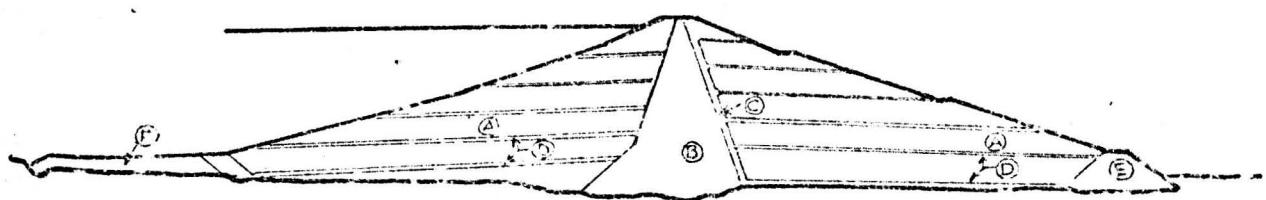
2770

VERRICK



SKETCH MAP SHOWING THE  
DIRECTION OF THE GLACIERS

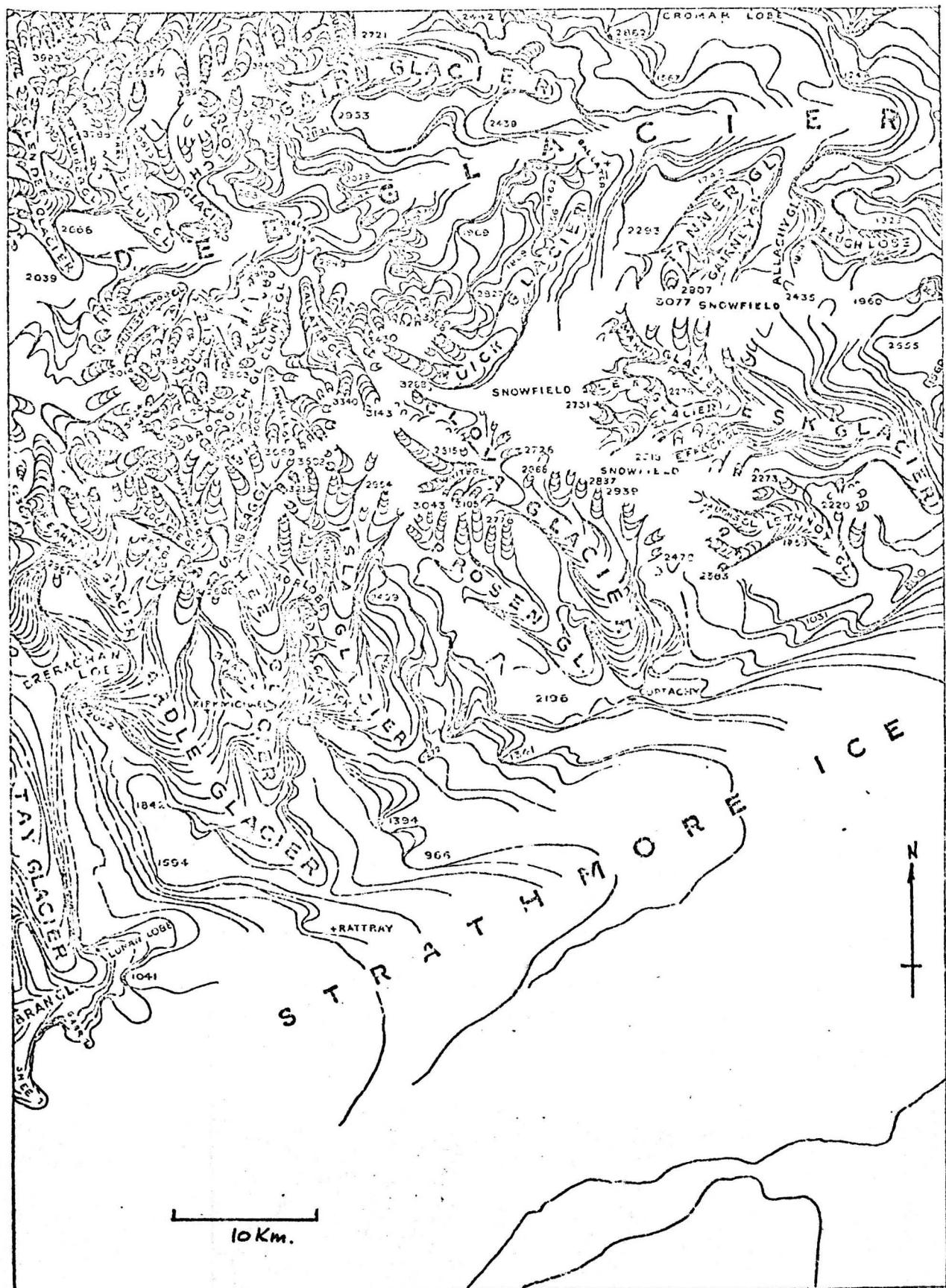
(not to scale)



- A. GLACIAL TILL CHULLERS.
- B. GLACIAL TILL CORE
- C. CHIMNEY DRAINS - GRAVEL
- D. LATERAL DRAINS - GRAVEL
- E. RUBBLE TOE WALL.
- F. SPOIL MATERIAL.

0      30      60  
SCALE IN METRES.

FIG. 4.16 MATERIALS IN BACKWATER DAM.



**FIG 4.17 MARGINS OF DEE, ESK-ARDLE AND OUTER TAY GLACIERS**

**(CHARLESWORTH 1956)**

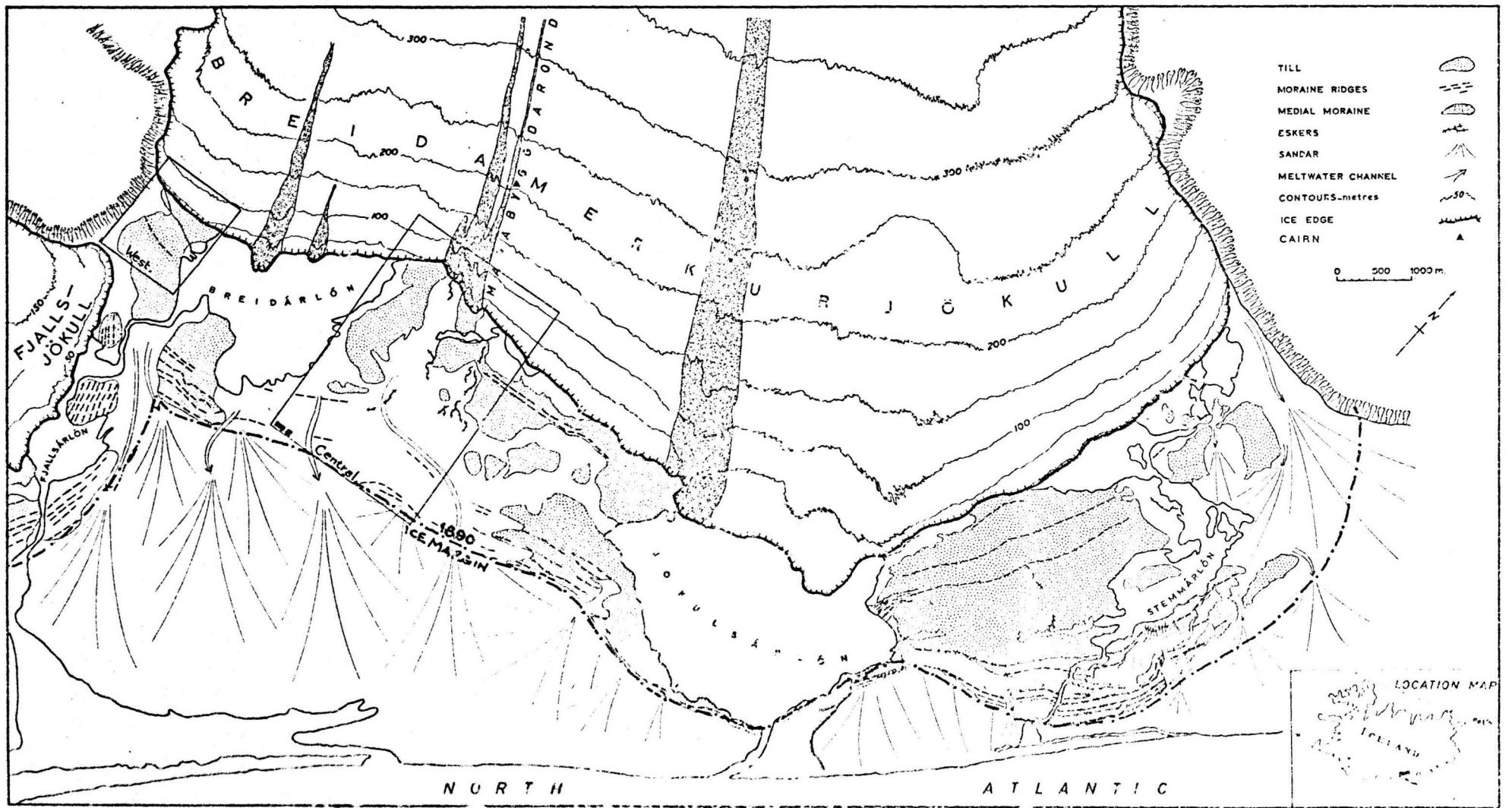
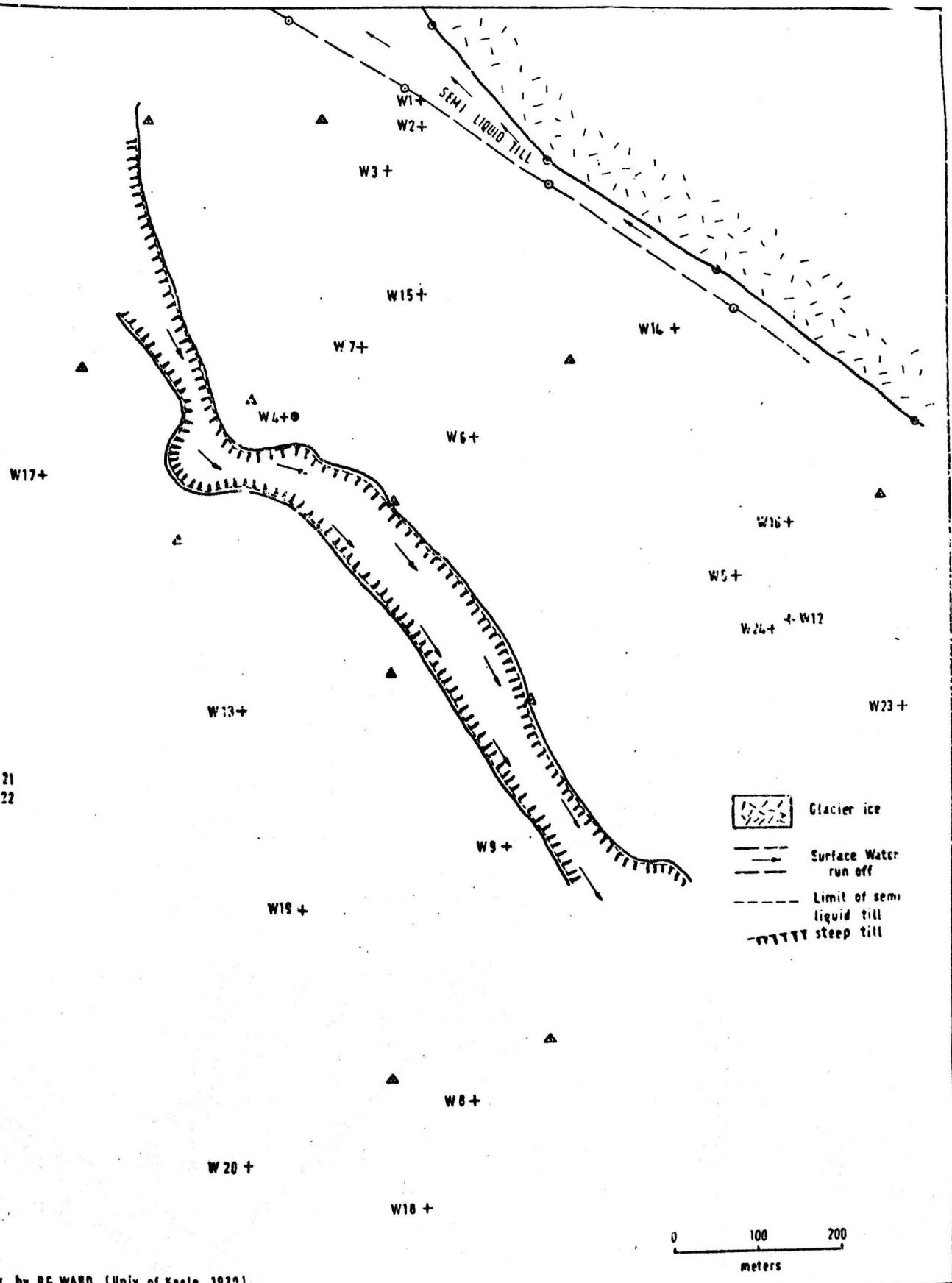


FIG. 4.18.

Breidamerkurjökull and its proglacial area

(AFTER PRICE, 1969).

MAGNETIC NORTH 406957.1970



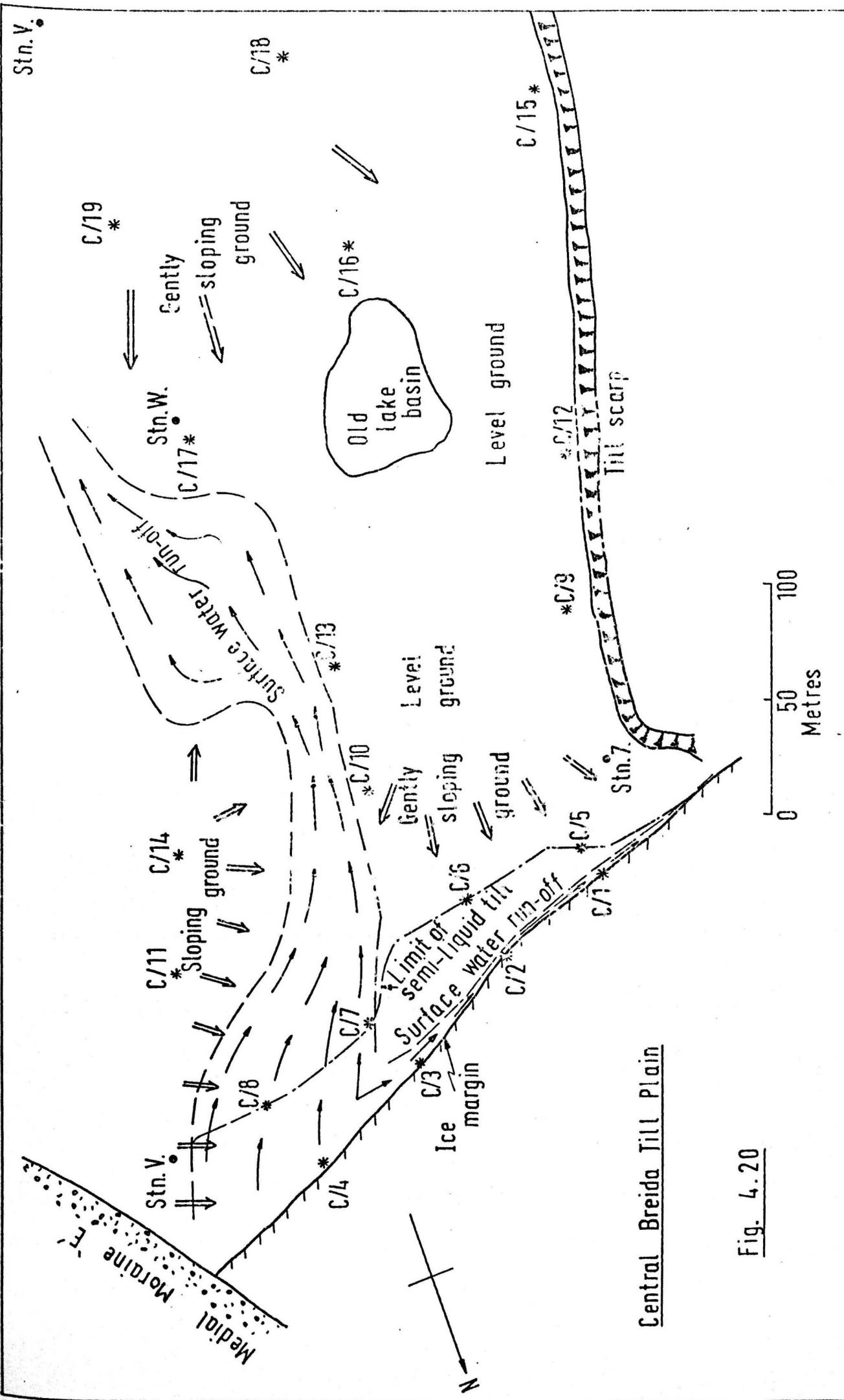


Fig. 4.20

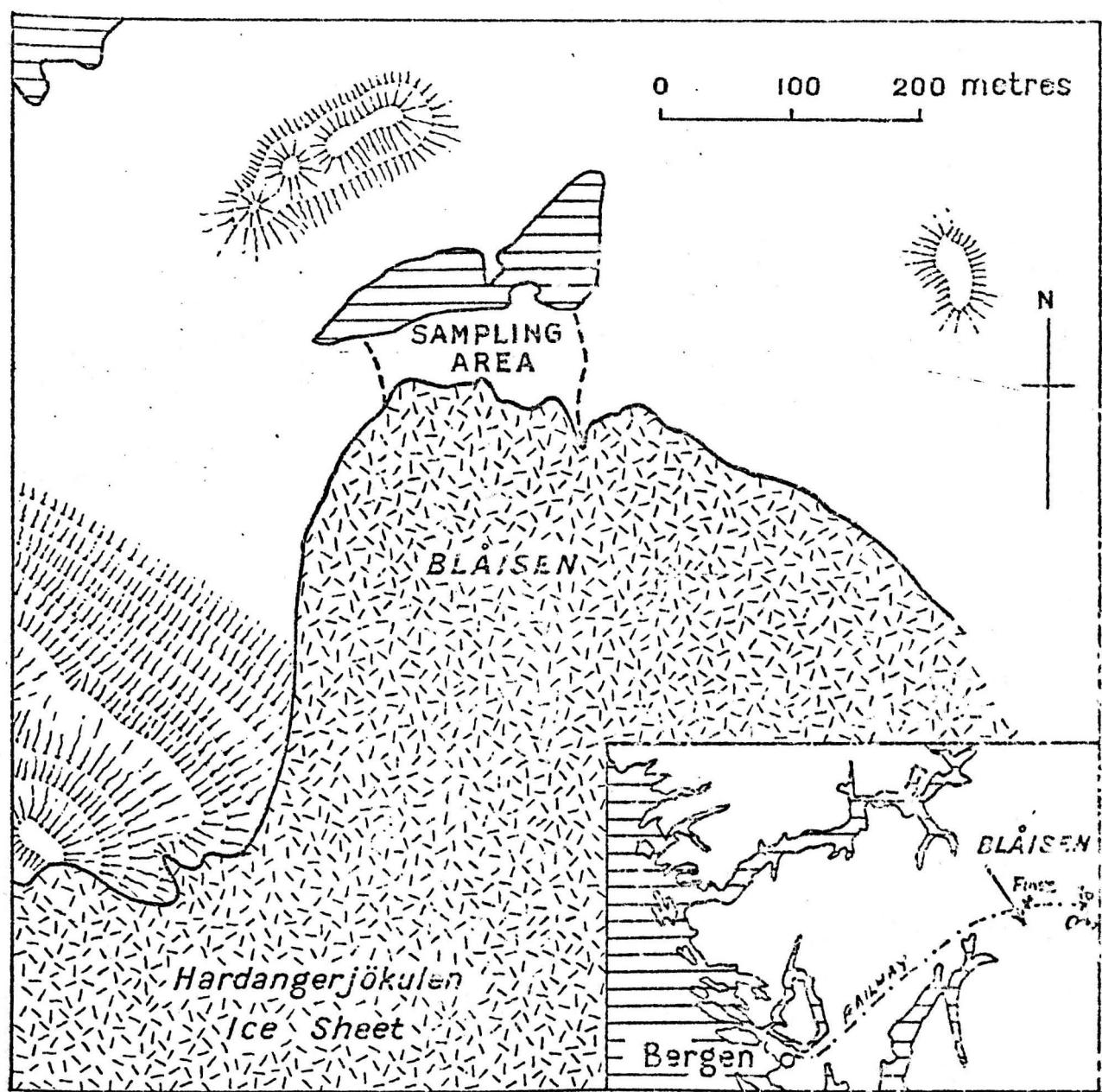


FIG 4.21. SAMPLING AREA AT BLÅISEN, SOUTHERN NORWAY.

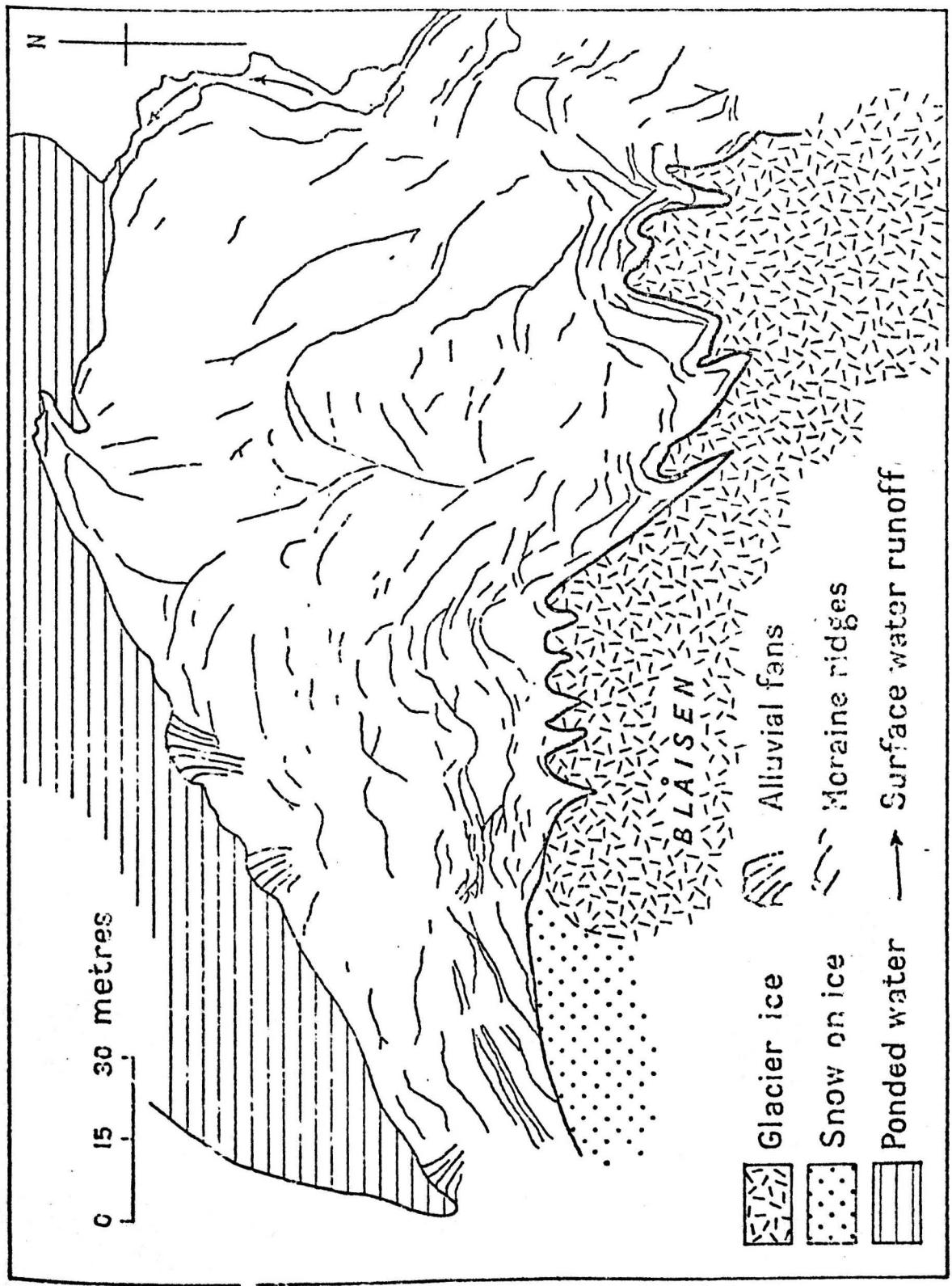


Fig. 4.22. PREGLACIAL FEATURES AT BLÅISEN SOUTHERN NORWAY

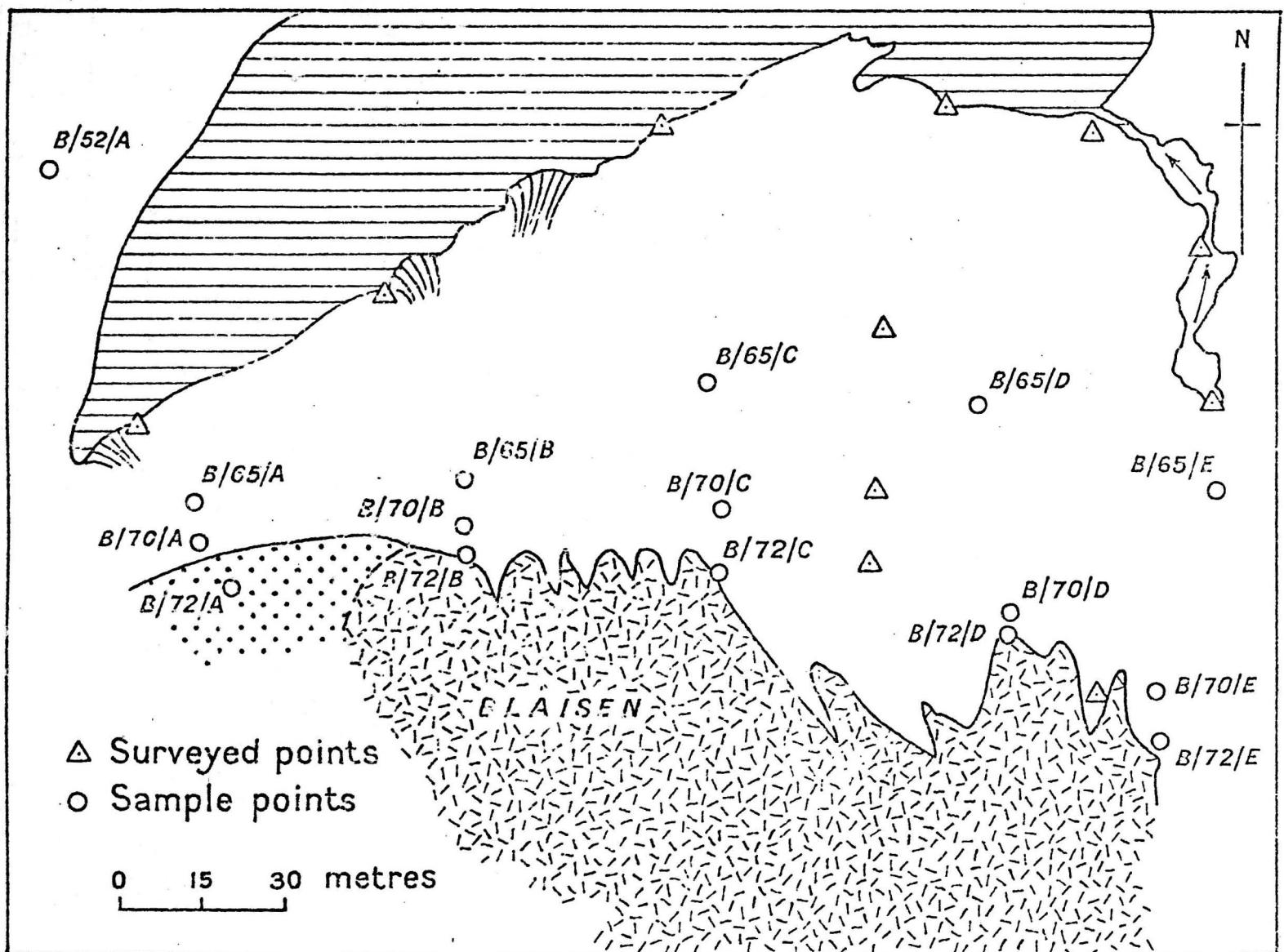


FIG. 4.23. SAMPLE POINTS AT BLÅISEN SOUTHERN NORWAY.

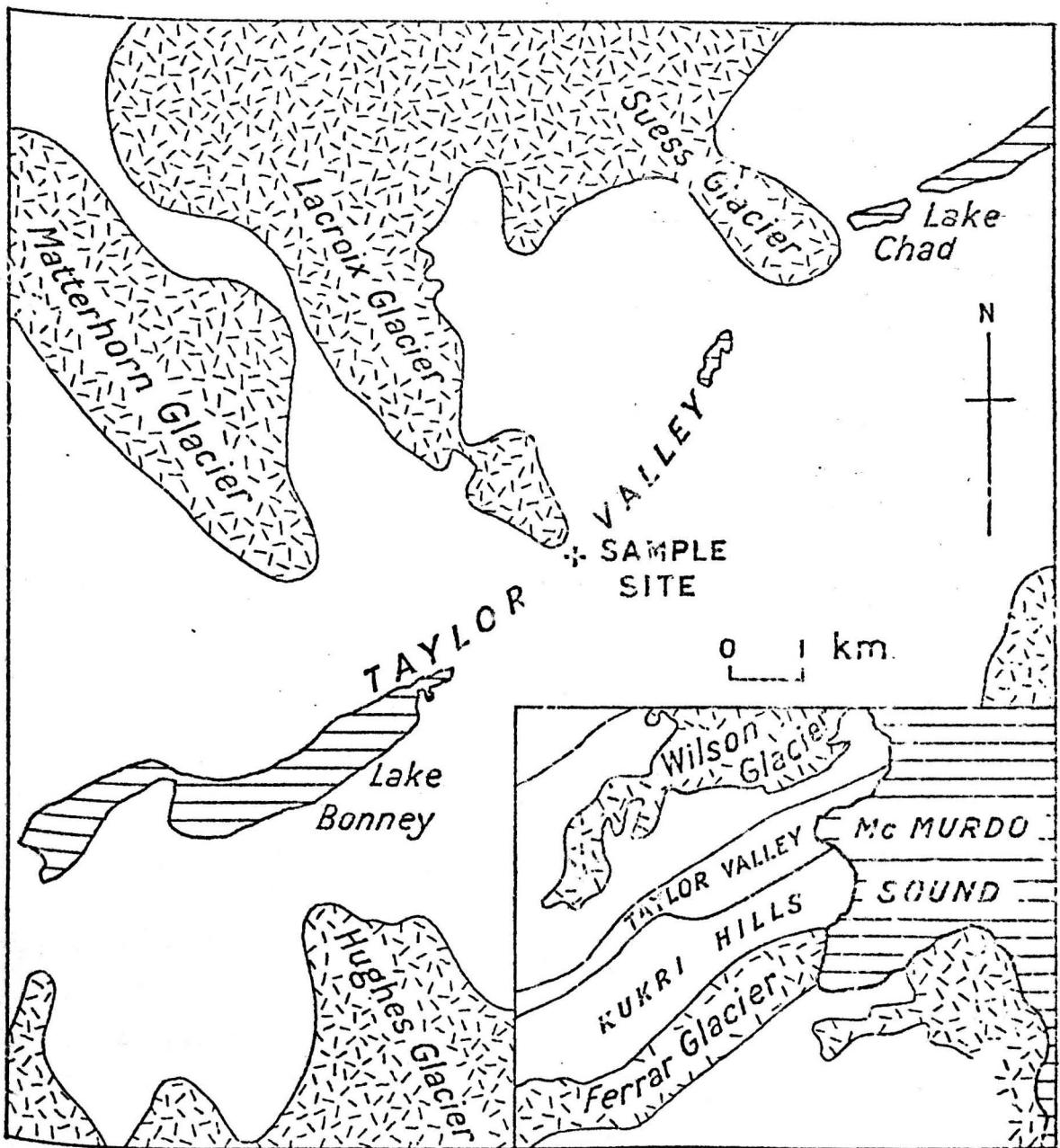


FIG. 4.24. LOCATION OF LACROIX GLACIER SAMPLE SITE.

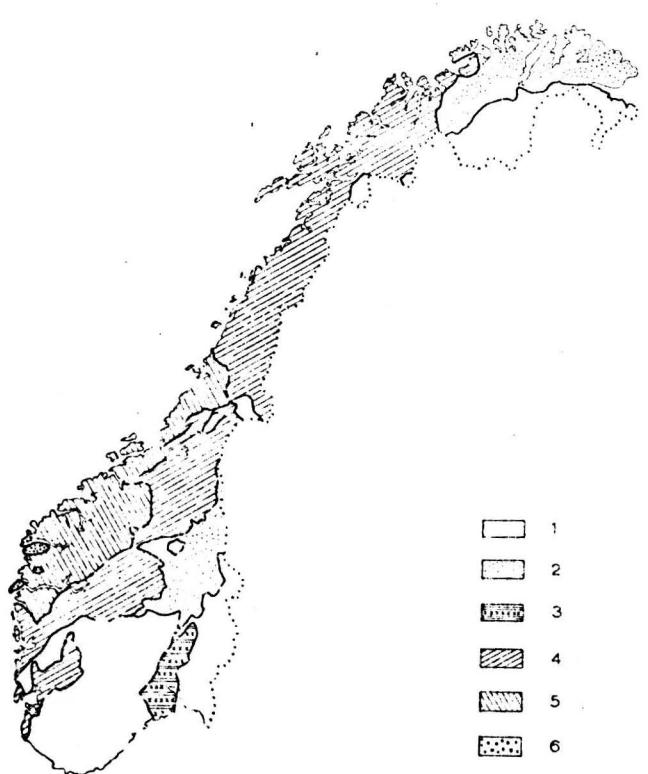
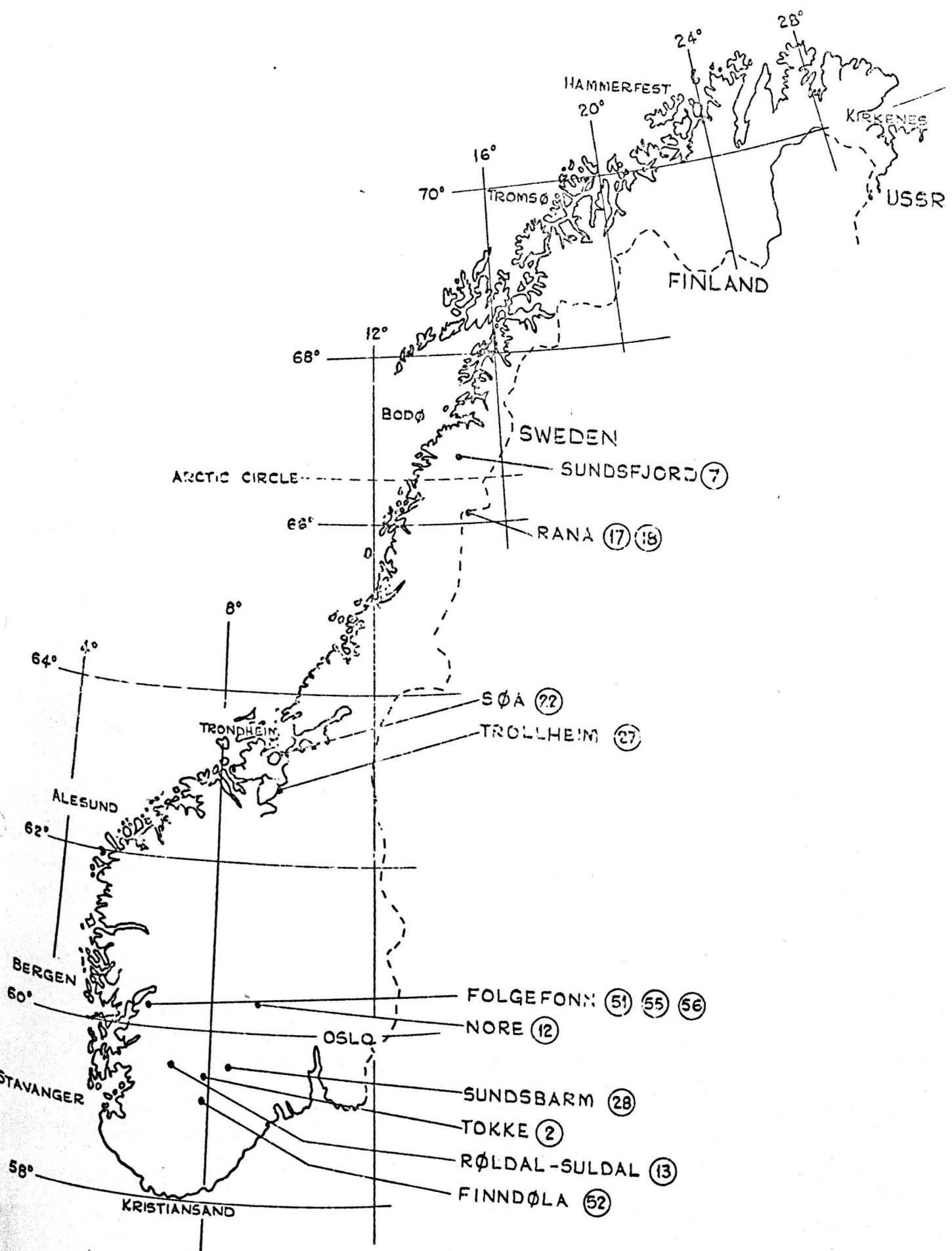


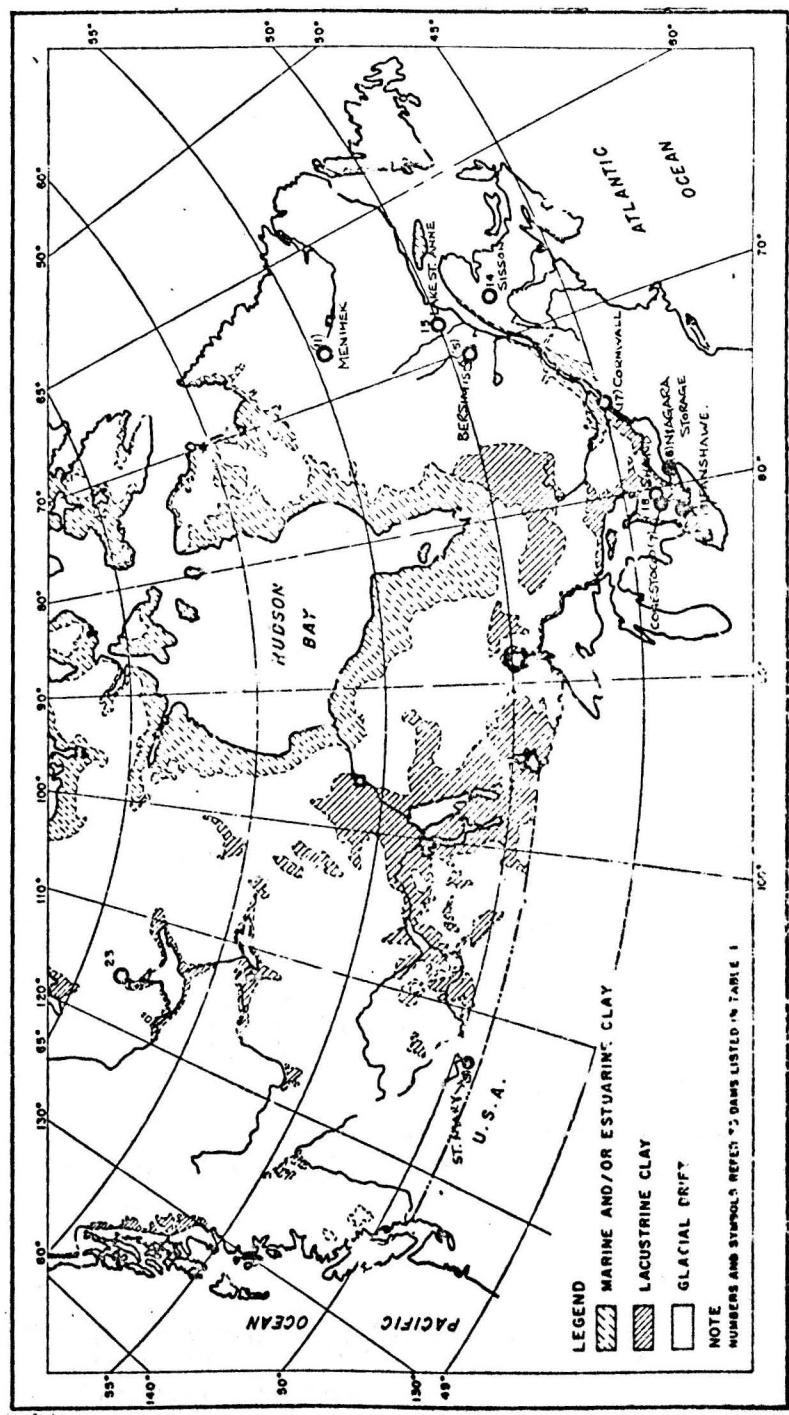
FIG. 4.25

Bedrock map of Norway. (1) Pre-Eocambrian rocks (mainly gneiss, granite, sandstone, quartzite). (2) Rocks of Eocambrian age (Sedimentary and gneissic rocks) (3) Cambro-Silurian sedimentary rocks and Permian effusive and plutonic rocks (4) Caledonian thrust masses and strongly altered Cambro-Silurian sedimentary rocks (5) Mainly gneissic rocks with Caledonian structure (6) Mainly Devonian sedimentary rocks.

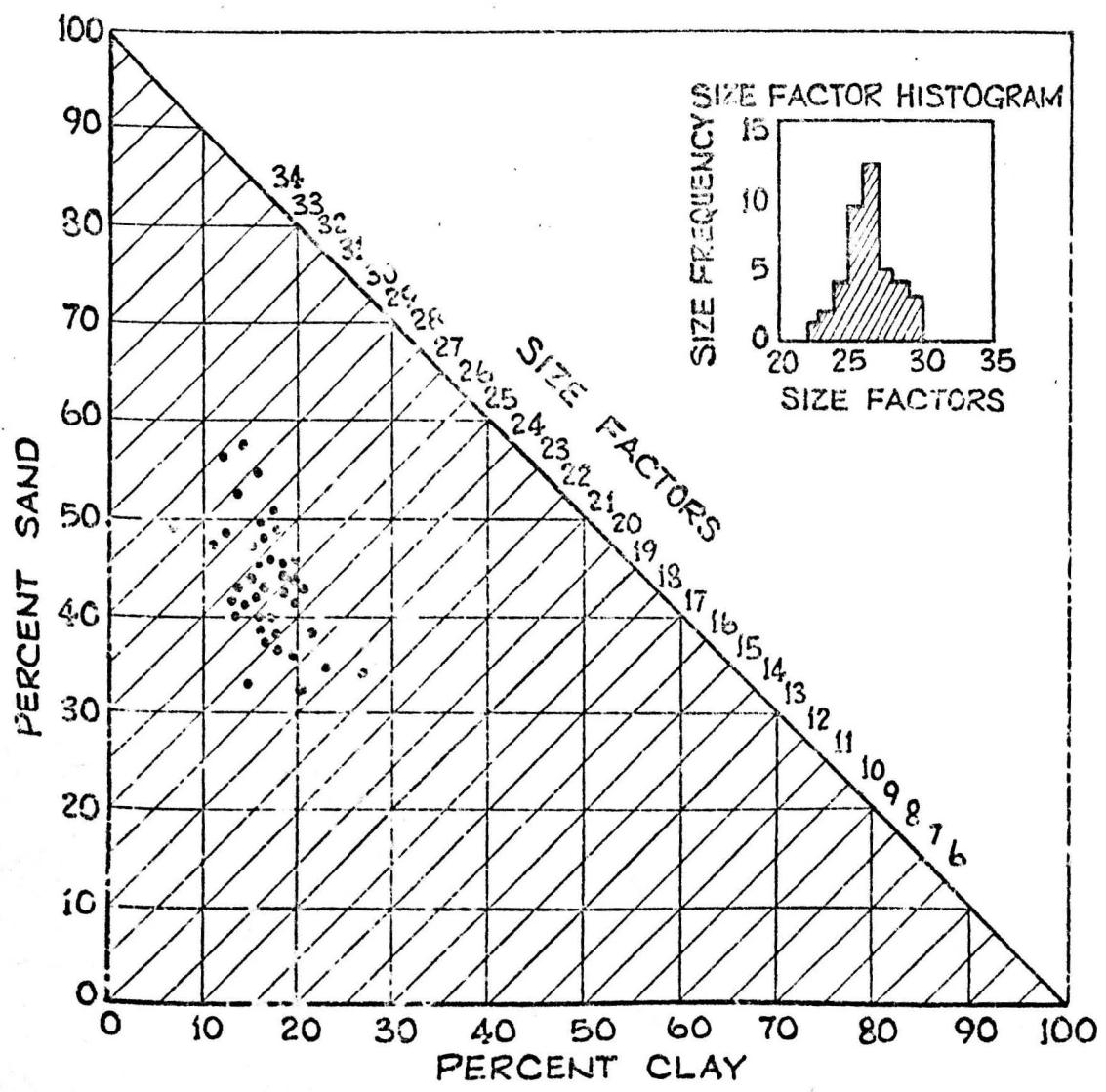
(Kjaernsli, 1968)

FIG. 4-26. LOCATIONS OF NORWEGIAN DAMS STUDIED





**FIG. 4.27.** Locations of Parcs in Canada With Respect to the Distribution of Dominant Surface Soil Groups.  
(McDONALD et al., 1961)



SIZE FACTORS GRAPH  
(AFTER SHEPPS 1958)

FIG. 5.1

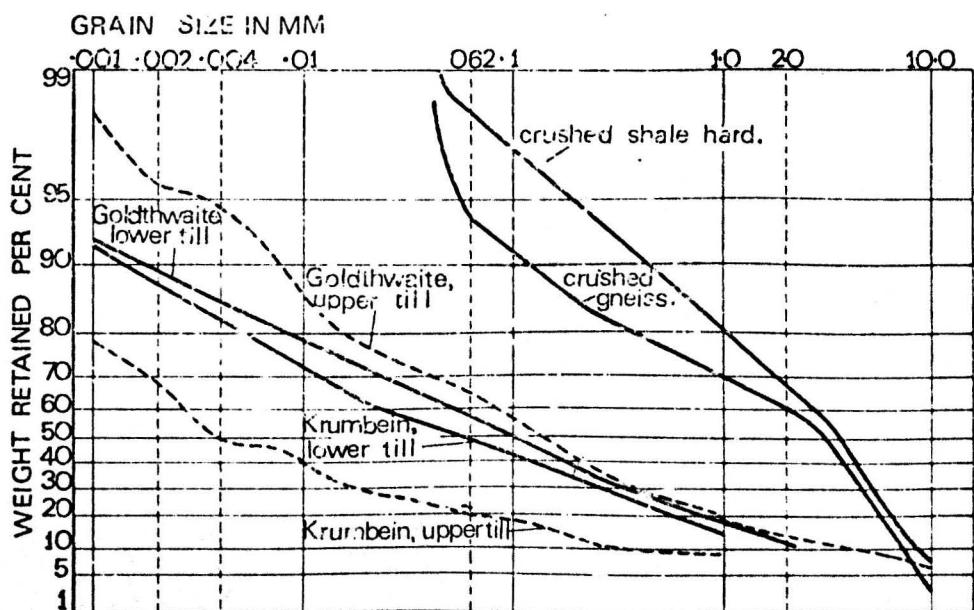
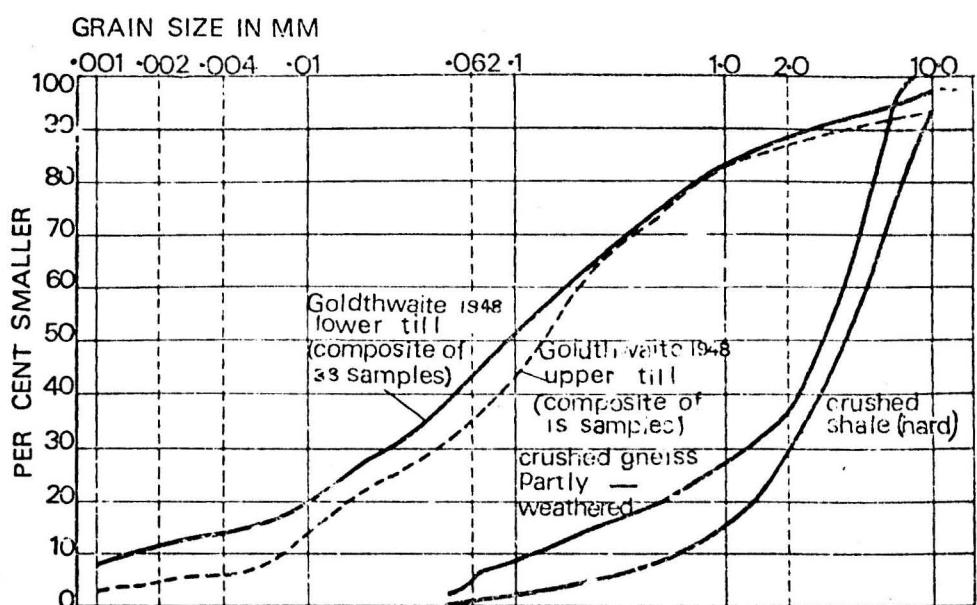


FIG. 5.2. GRAIN SIZE DISTRIBUTION OF TILLS FROM ELSON (1961).

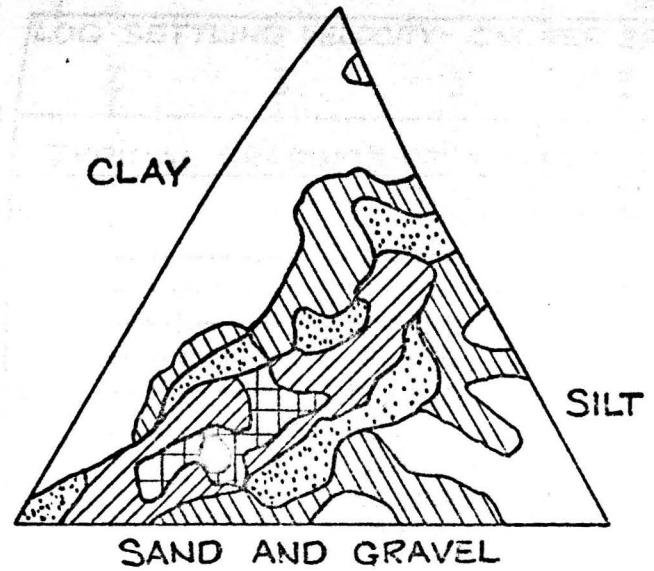
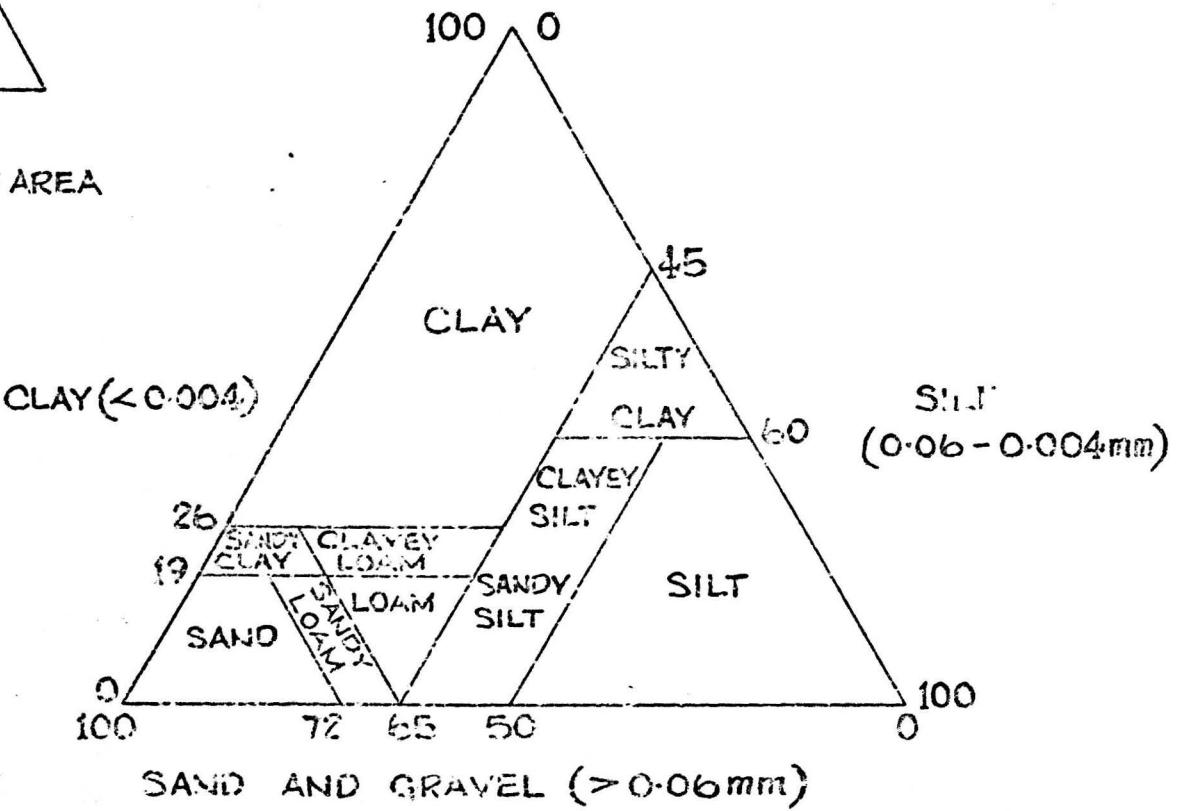


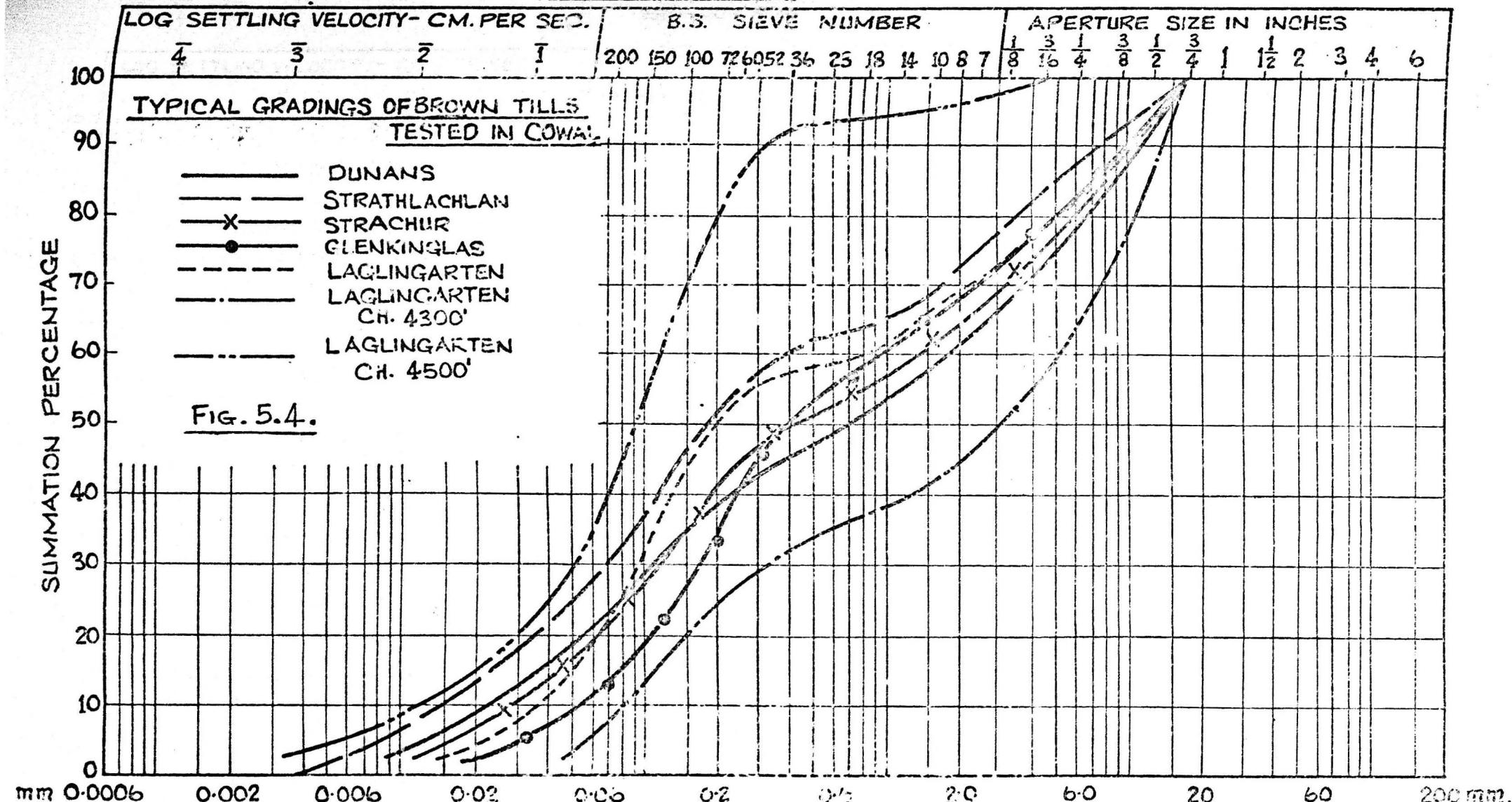
FIG. 5.3.  
TRIANGULAR  
GRAIN SIZE DISTRIBUTION FOR  
ABOUT 500 TILLS - BY ELSON (1961)

Nº OF ANALYSIS PER 0.5% OF AREA

0	□	1-2	▨	3-5	■
6-10	▨	11-15	▨	16-20	□



PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT



CLAY FRACTION	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS	S.
	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION				1377

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

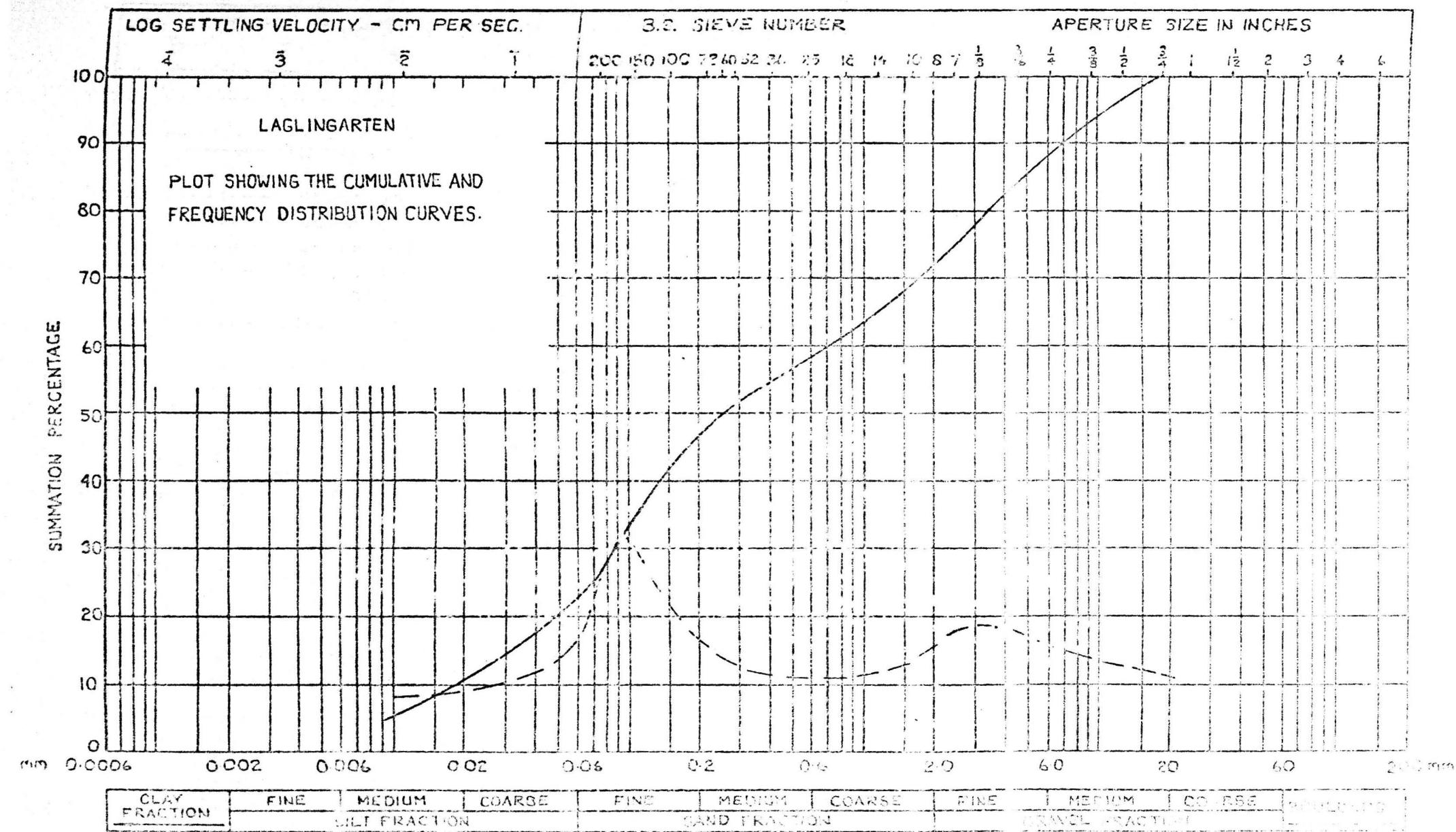


FIG. 5.5 CUMULATIVE AND FREQUENCY DISTRIBUTION CURVES FOR LAGLINGARTEN SOIL

PARTICLE SIZE DISTRIBUTION

LOG PROBABILITY PLOT

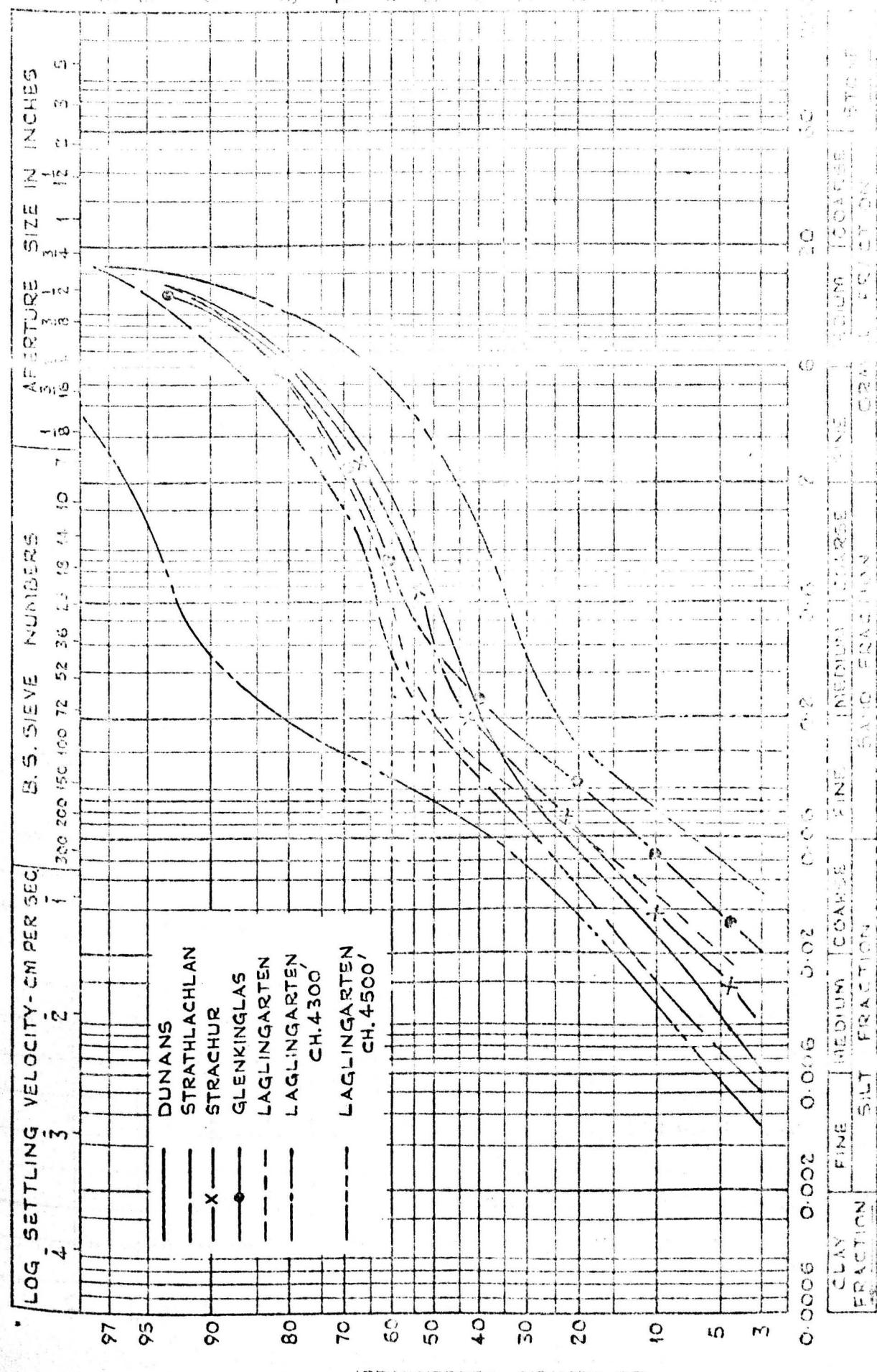


FIG. 5.6. LOG PROBABILITY PLOT OF PARTICLE SIZE DISTRIBUTION

PARTICLE SIZE DISTRIBUTION

C - PROBABILITY PLOT

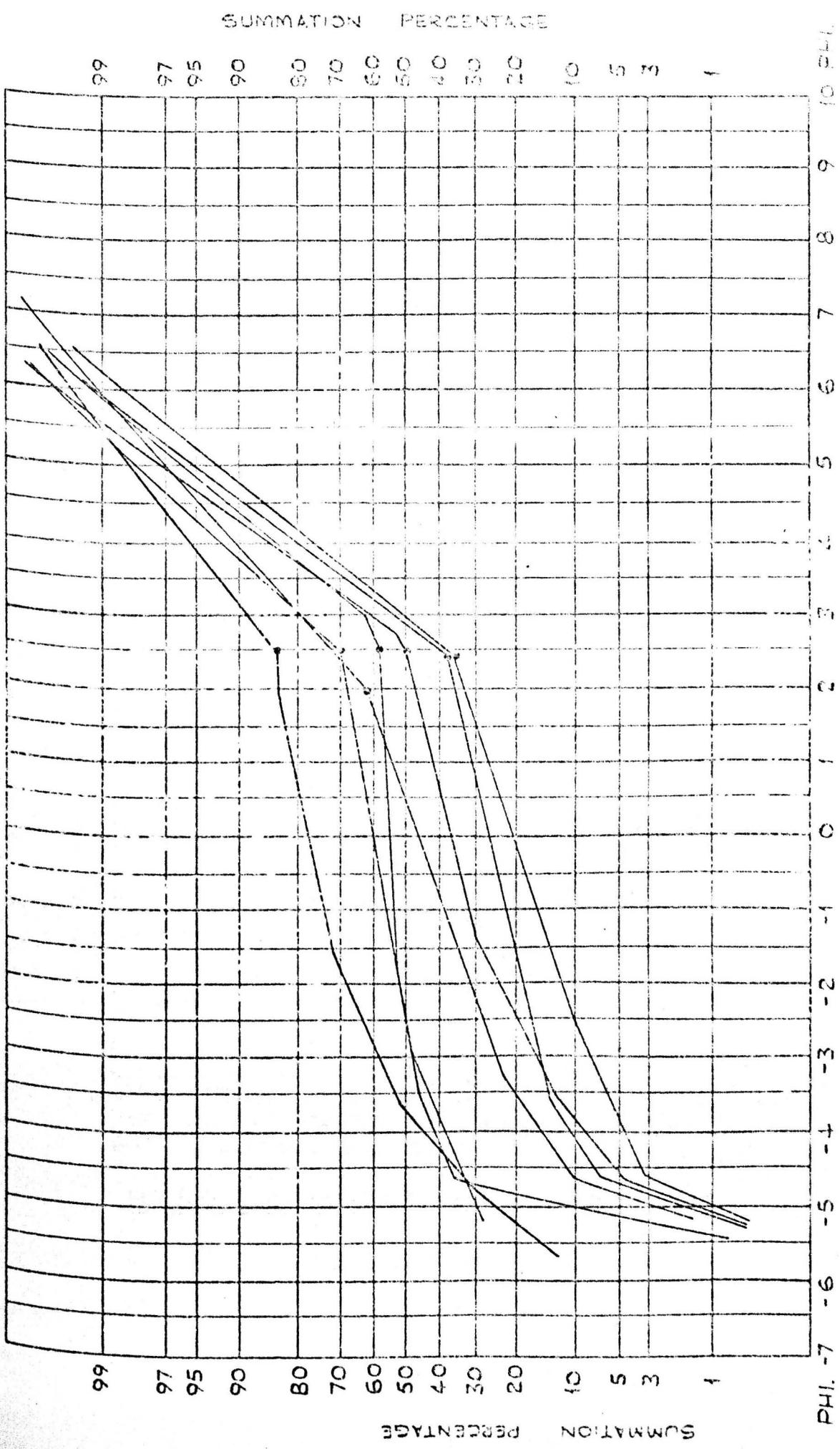


FIG. 5.7. *Distribution Probability Plot of Various Clay Fractions.*

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

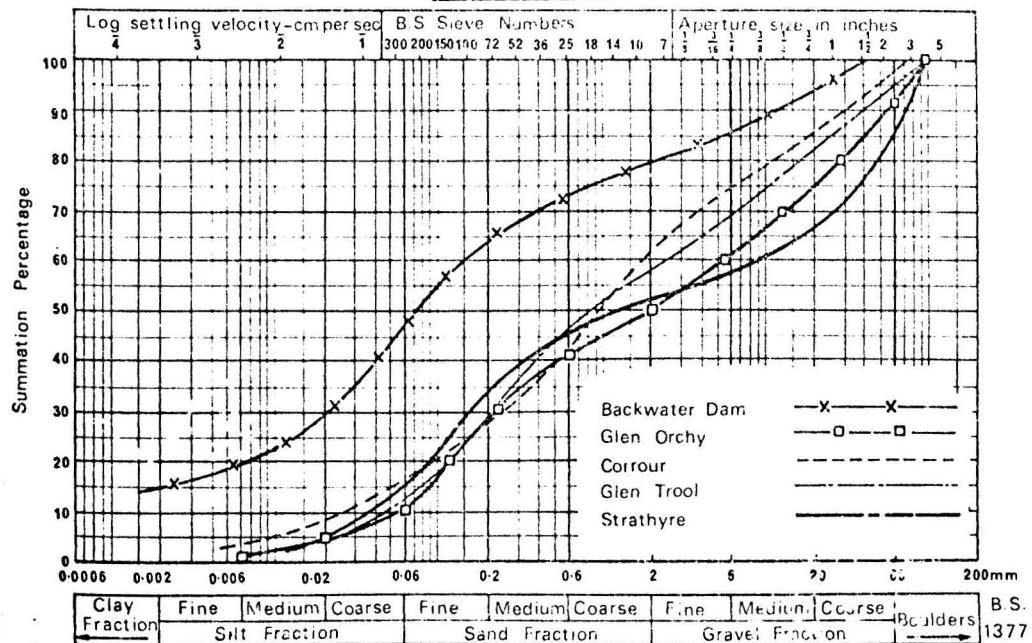


FIG. 5.8. SEMI-LOG PLOT OF OTHER SCOTTISH TILLS.

PARTICLE SIZE DISTRIBUTION  
LCC PROBABILITY PLOT

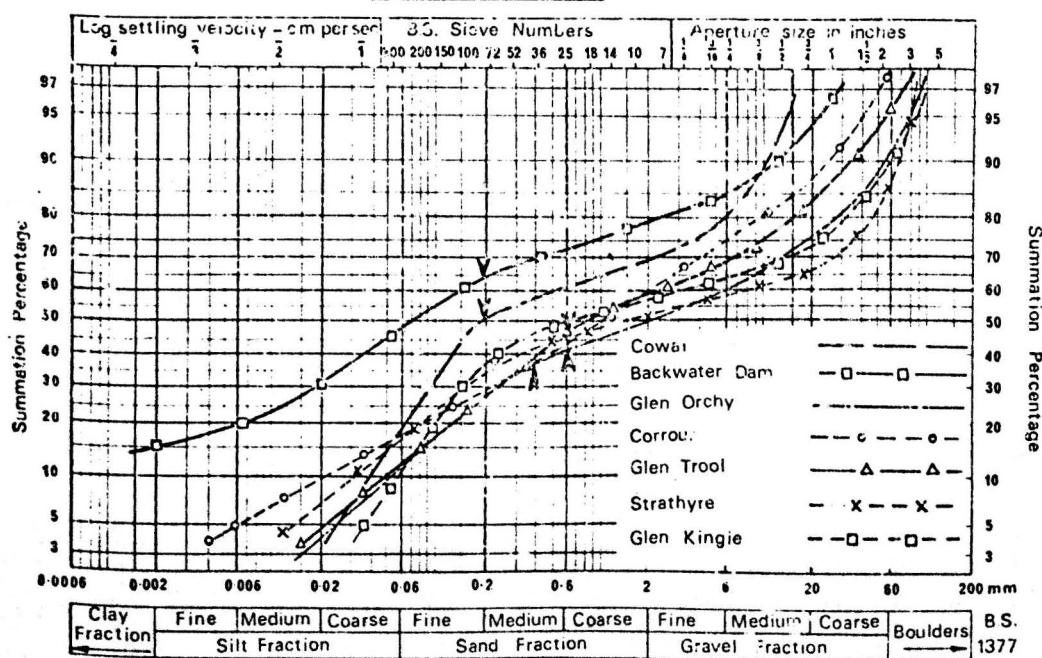


FIG 5.9. LOG-PROBABILITY PLOT OF SCOTTISH TILLS.

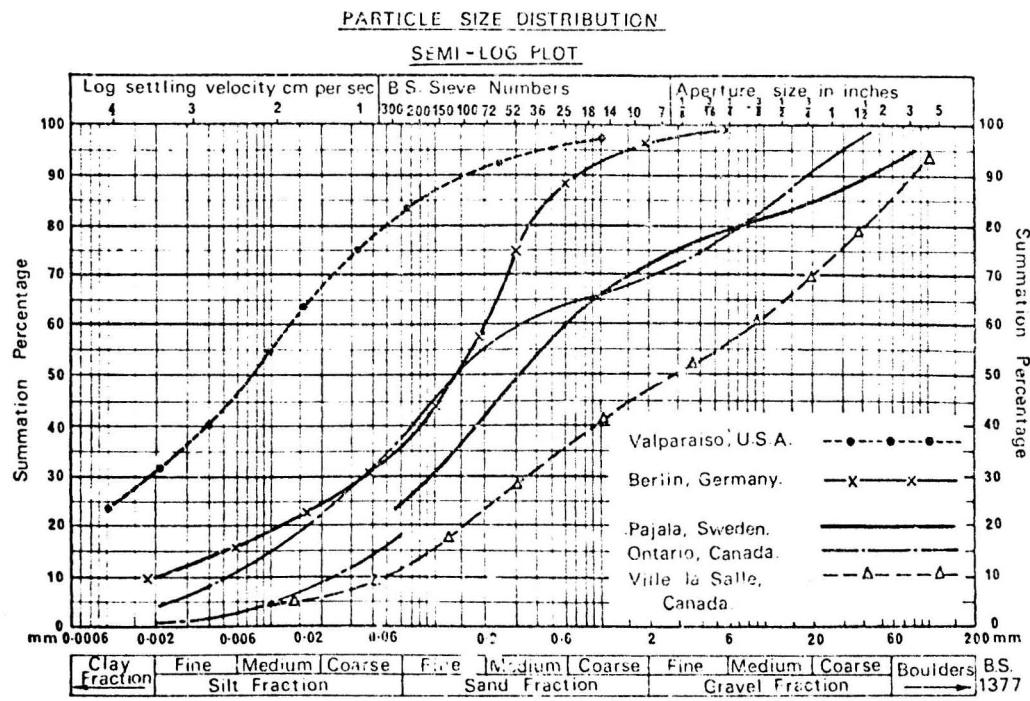


FIG. 5.10. SEMI-LOG PLOT FOR FOREIGN TILLS.

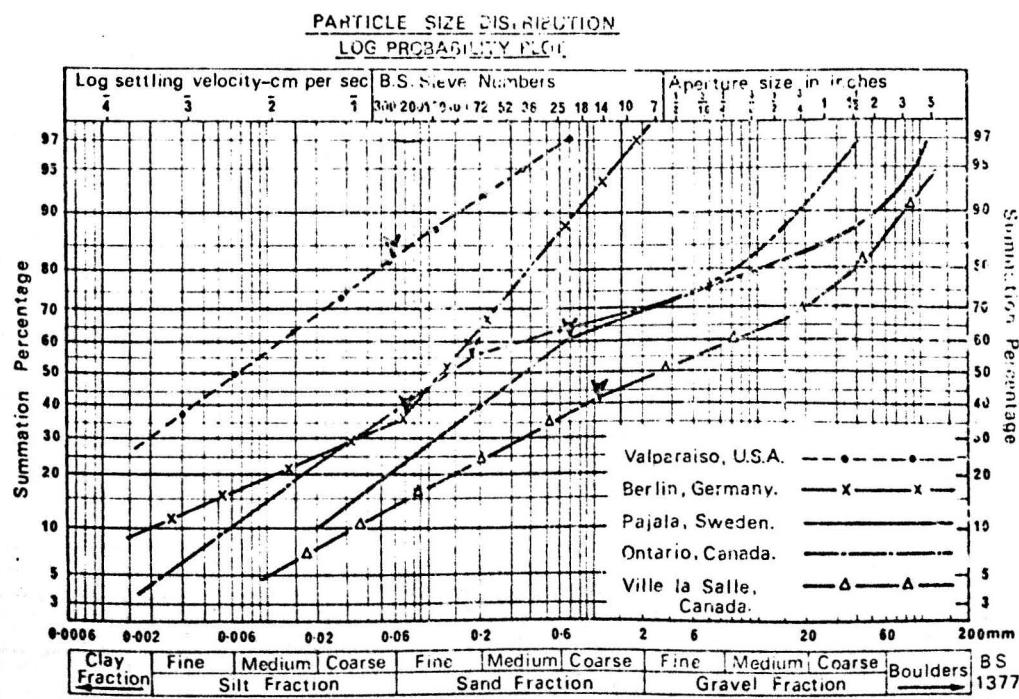


FIG. 5.11. LOG-PROBABILITY FOR FOREIGN TILLS.

## PARTICLE SIZE DISTRIBUTION

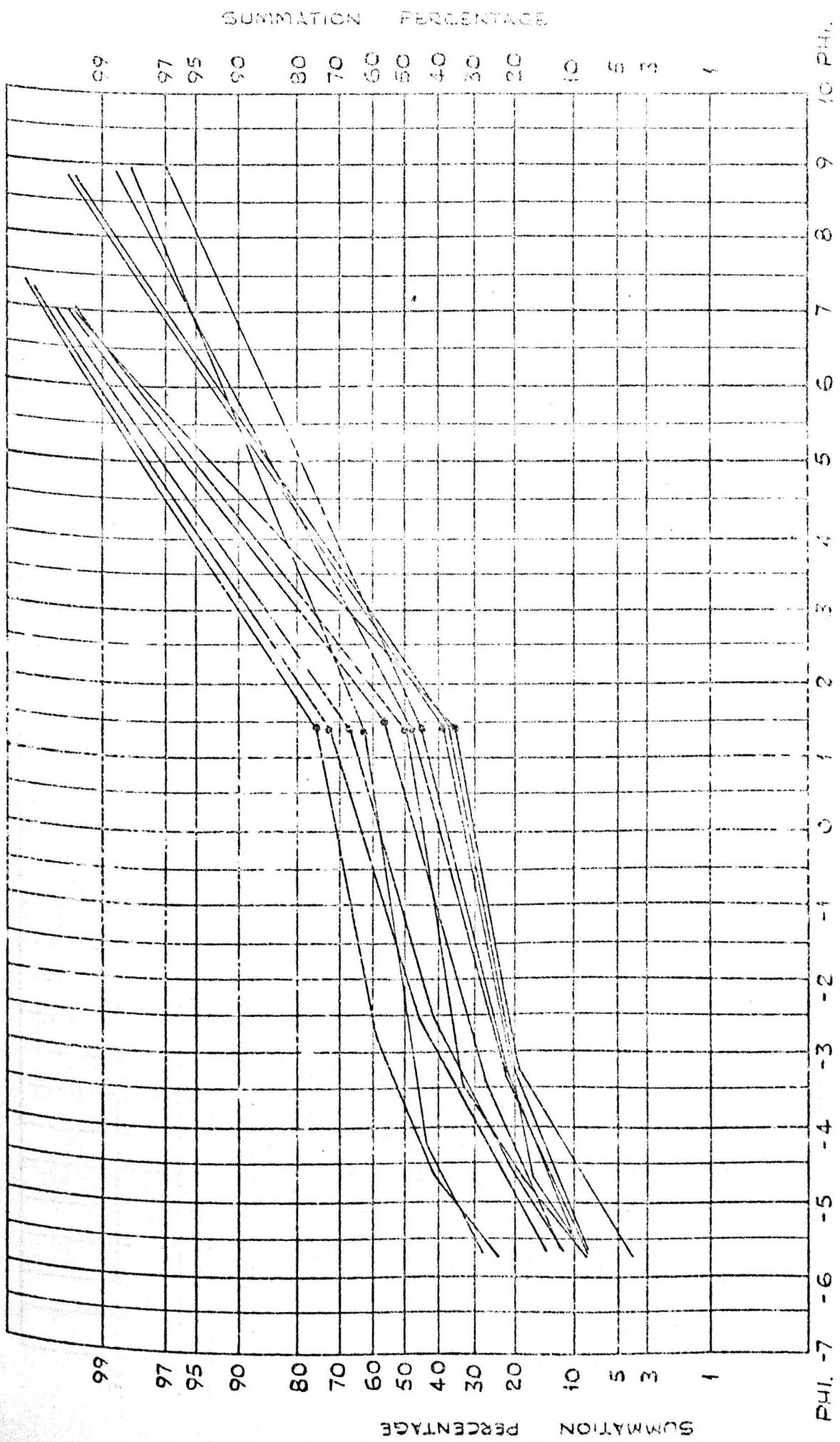


FIG. 5.12. DIL. ACCURACY TEST FOR THE DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION

NO. OF TESTS  
IN A SERIES  
TESTS

CLAY

COARSE

SILT

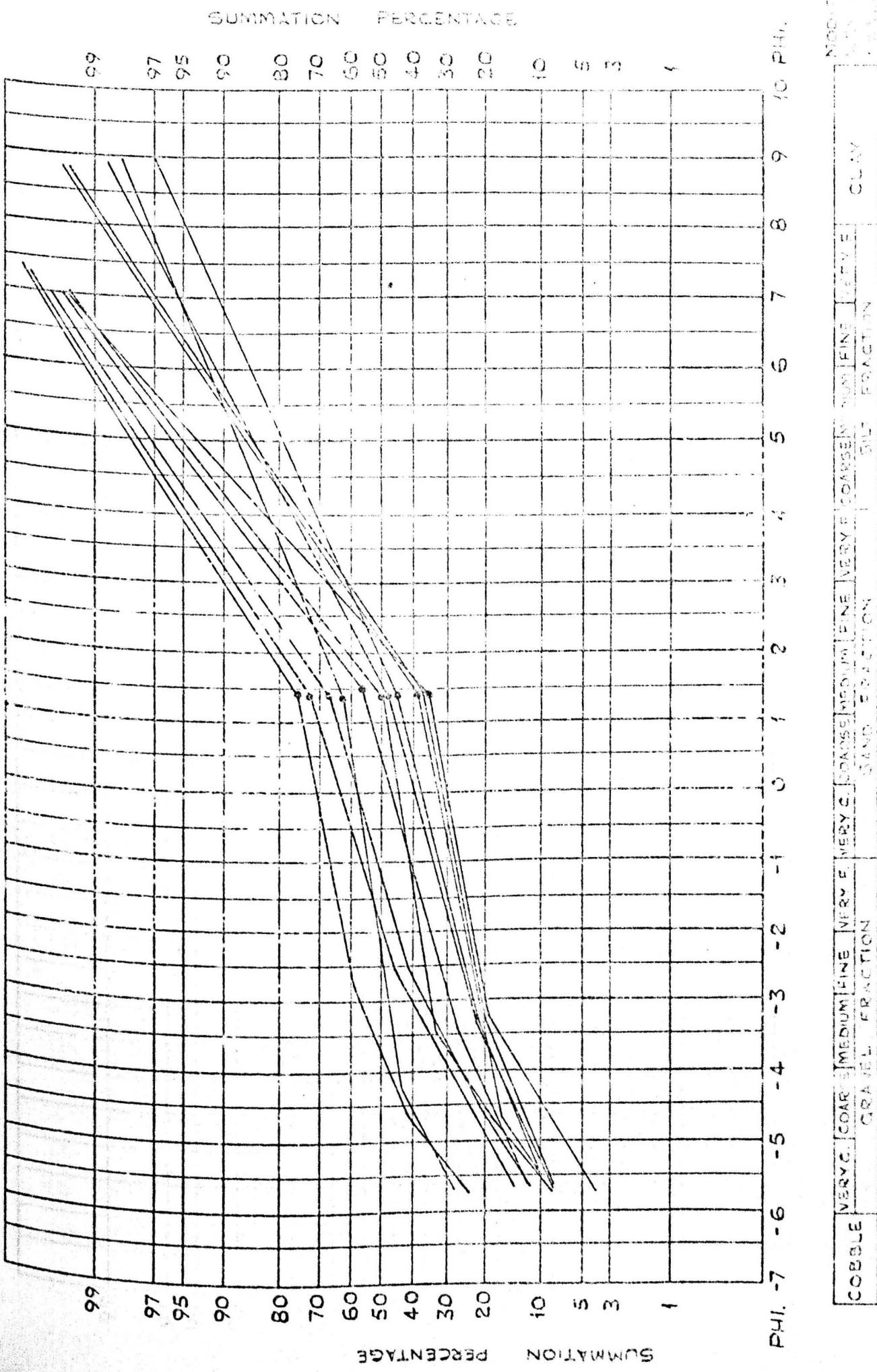
SAND

GRAVEL

COBBLE

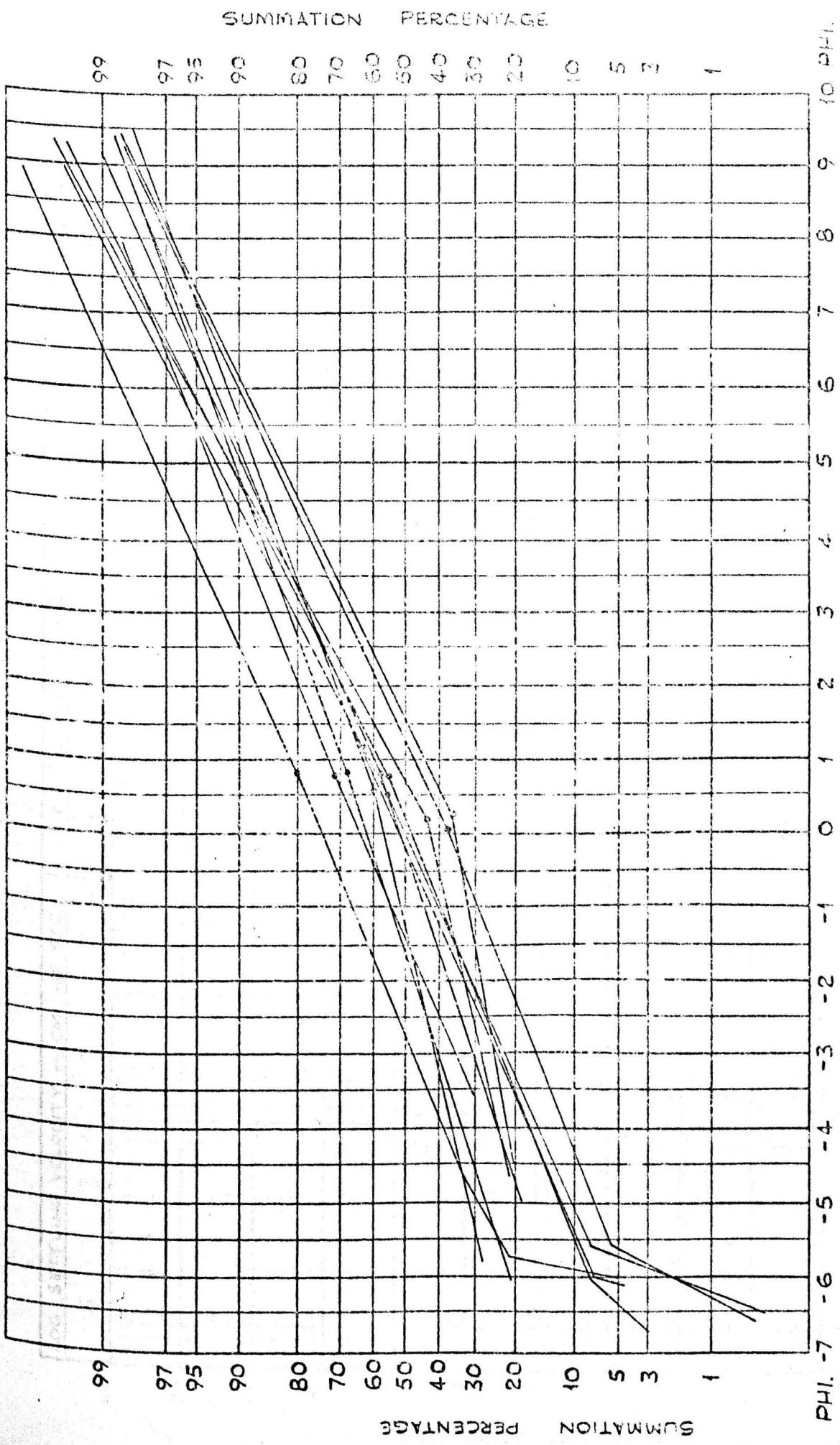


P - PROBABILITY - PLOT



$\phi$ -PROBABILITY PLOT.

PARTICLE SIZE DISTRIBUTION



COBBLE	VERY COARSE GRAVEL FRACTION	MEDIUM GRAVEL FRACTION	VERY FINE GRAVEL FRACTION	COARSE SAND FRACTION	MEDIUM SAND FRACTION	FINE SAND FRACTION	CLAY
1	2	3	4	5	6	7	8

FIG. 5.13.  $\phi$ -PROBABILITY PLOT FOR CONSTRUCTION MATERIALS.

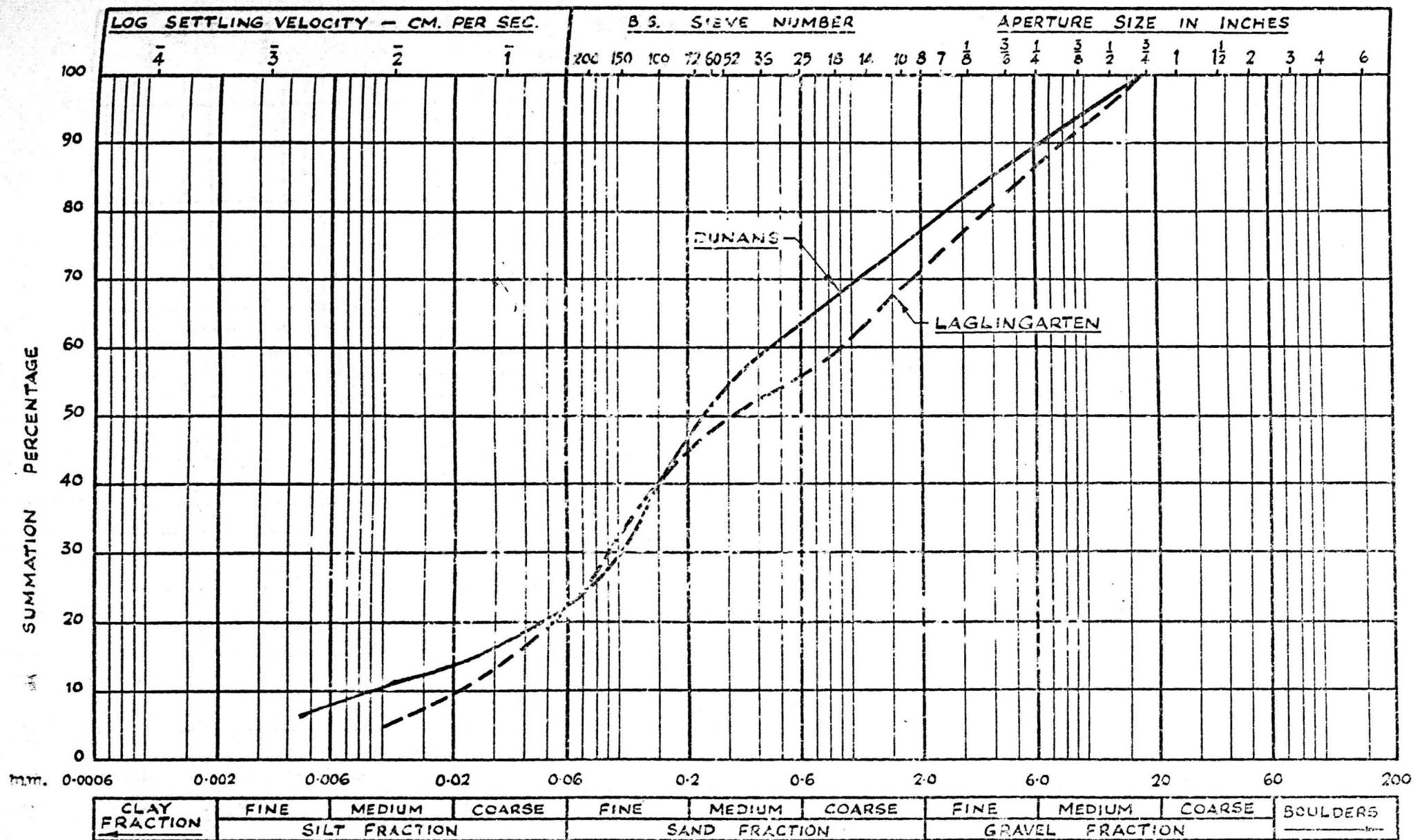


FIG. 5.14. TYPICAL GRADING OF GREY COWAL TILL.

PARTICLE SIZE DISTRIBUTION

LOG-PROBABILITY PLOT

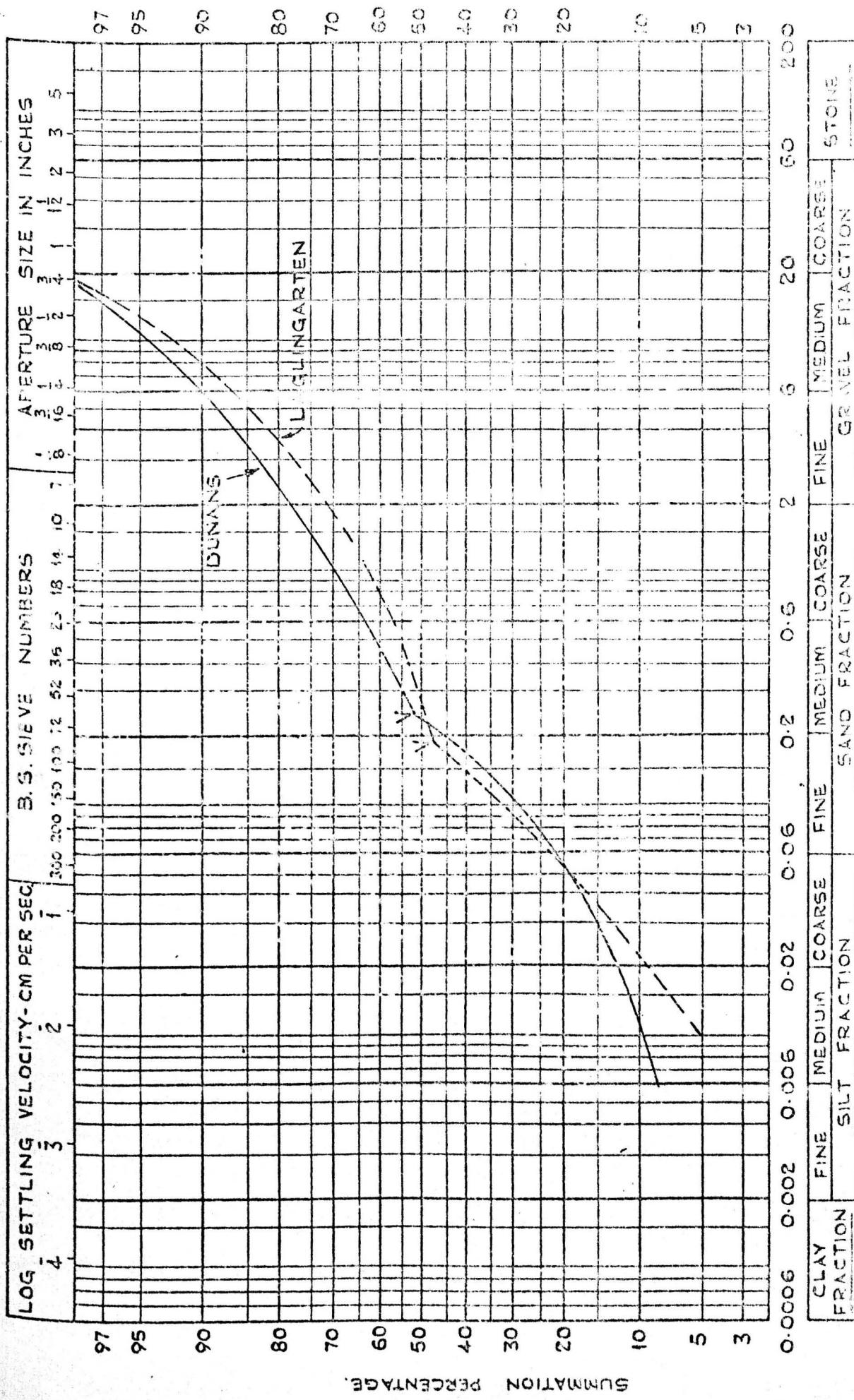


FIG. 5.15. The suggestion part of Gray's *Concordance*.

PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT

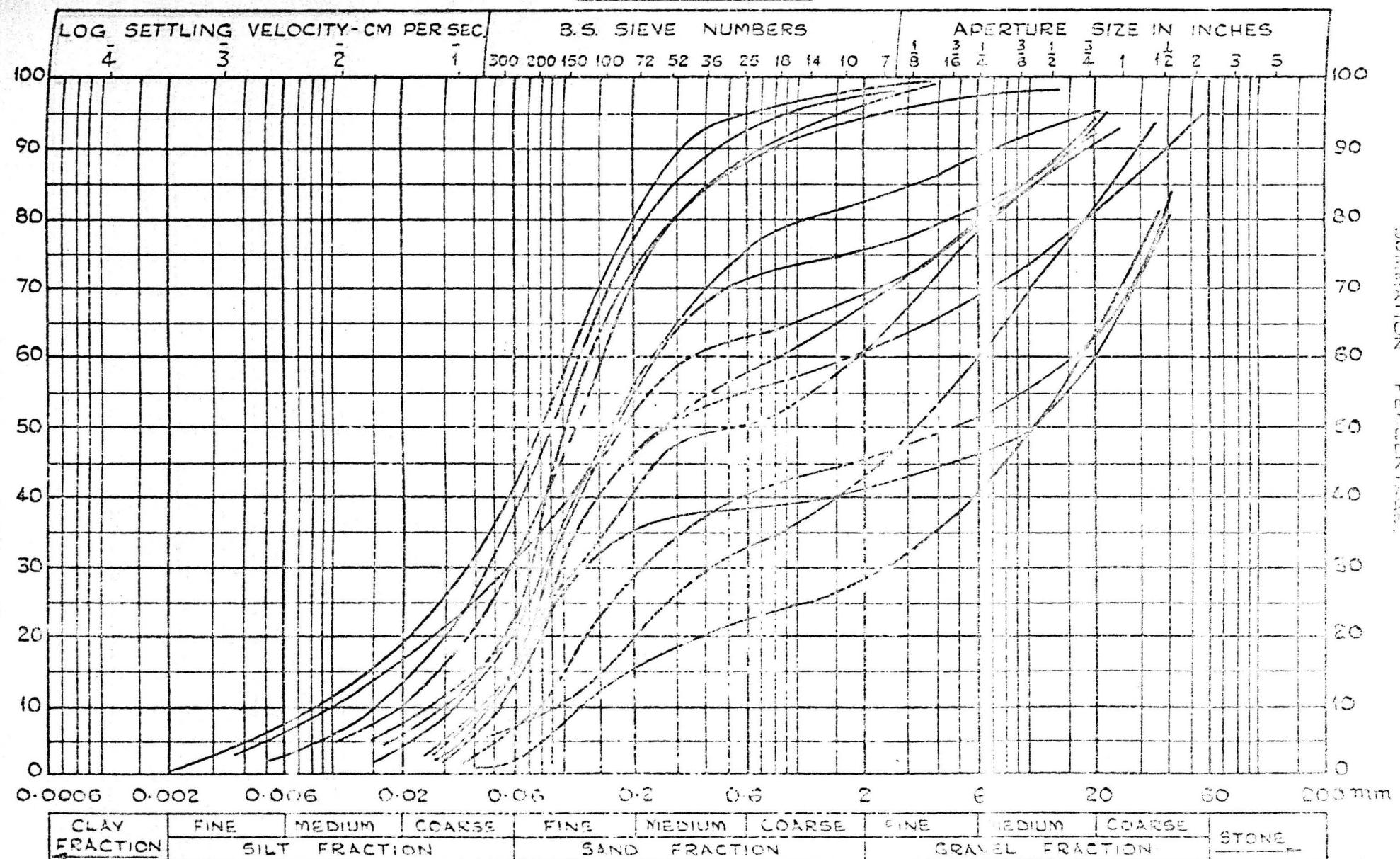
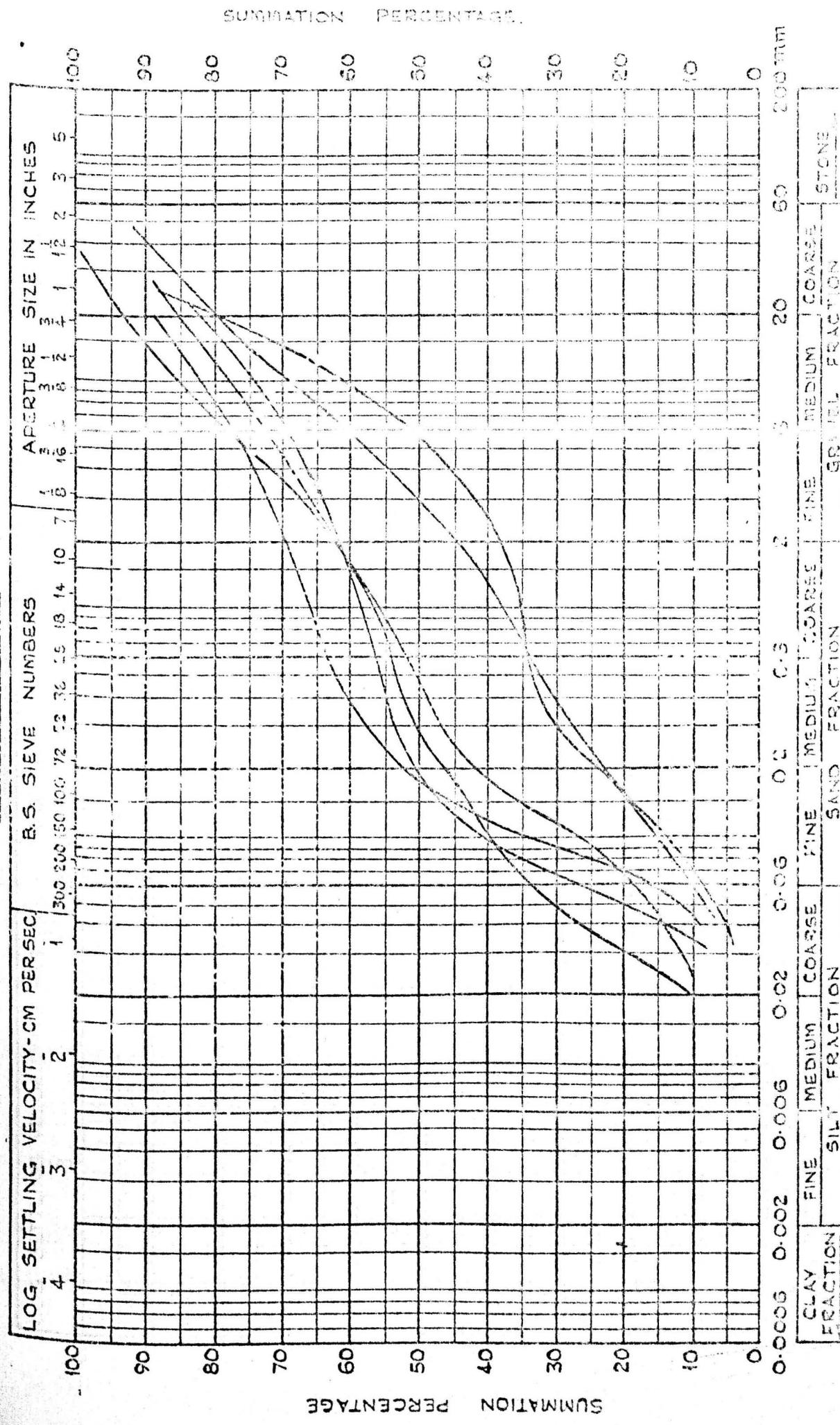


FIG. 5.16 RANGE OF GRADINGS FOR LACONIA-SUZETTE SOIL.

PARTICLE SIZE DISTRIBUTION

### SEMI-LOG PLOT



PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT

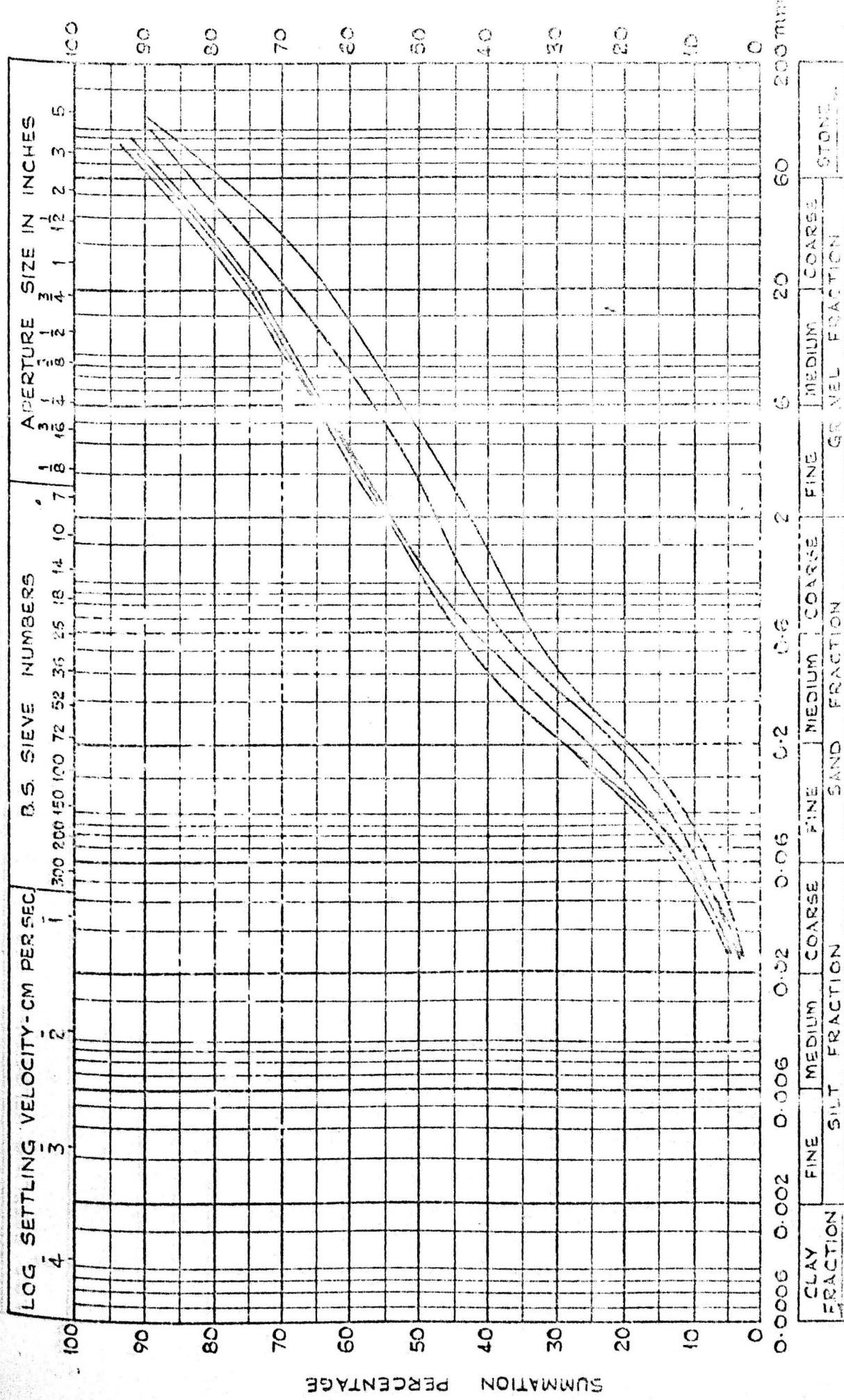
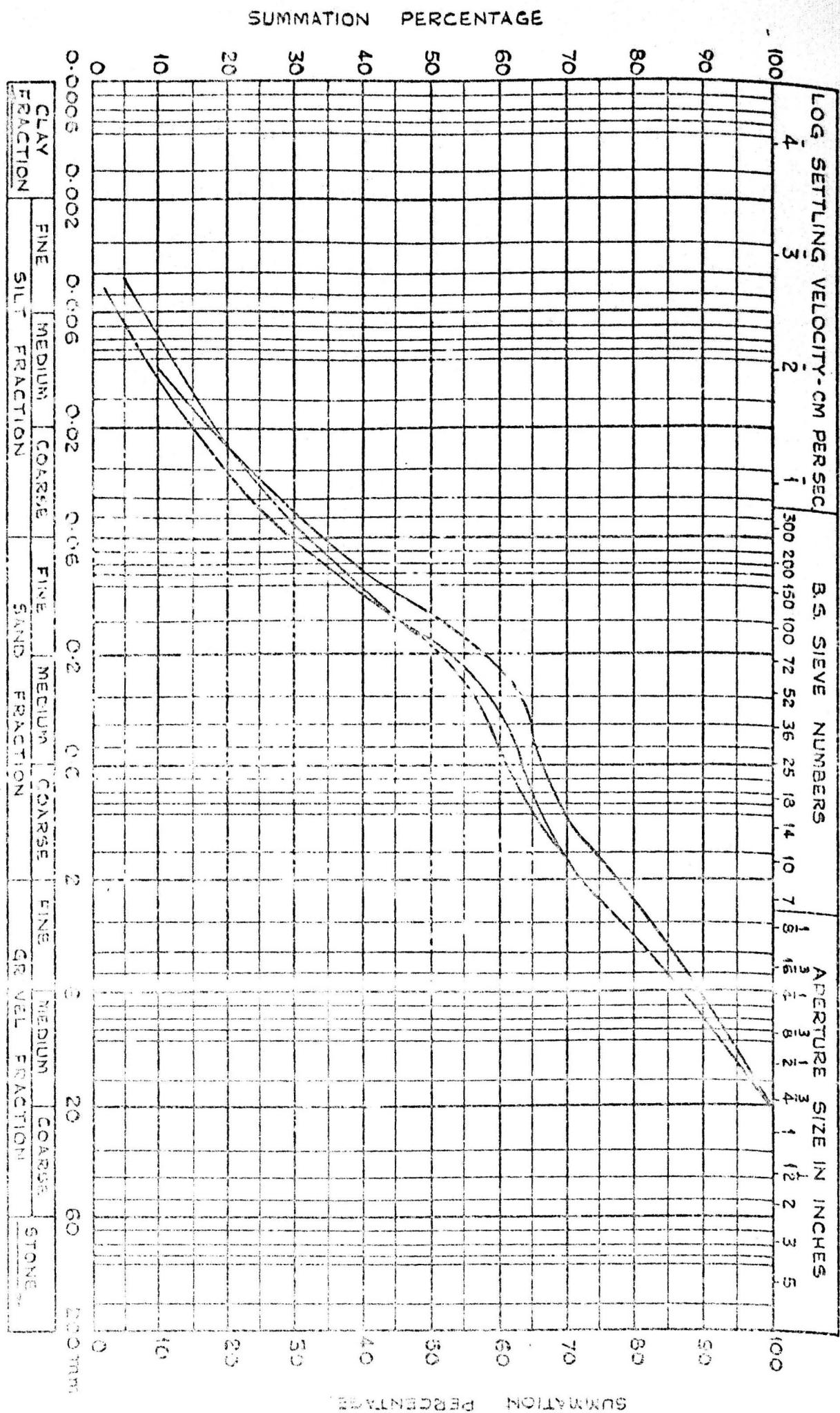


FIG. 5-4C. GLEN KINGS' RULE CHARTS.

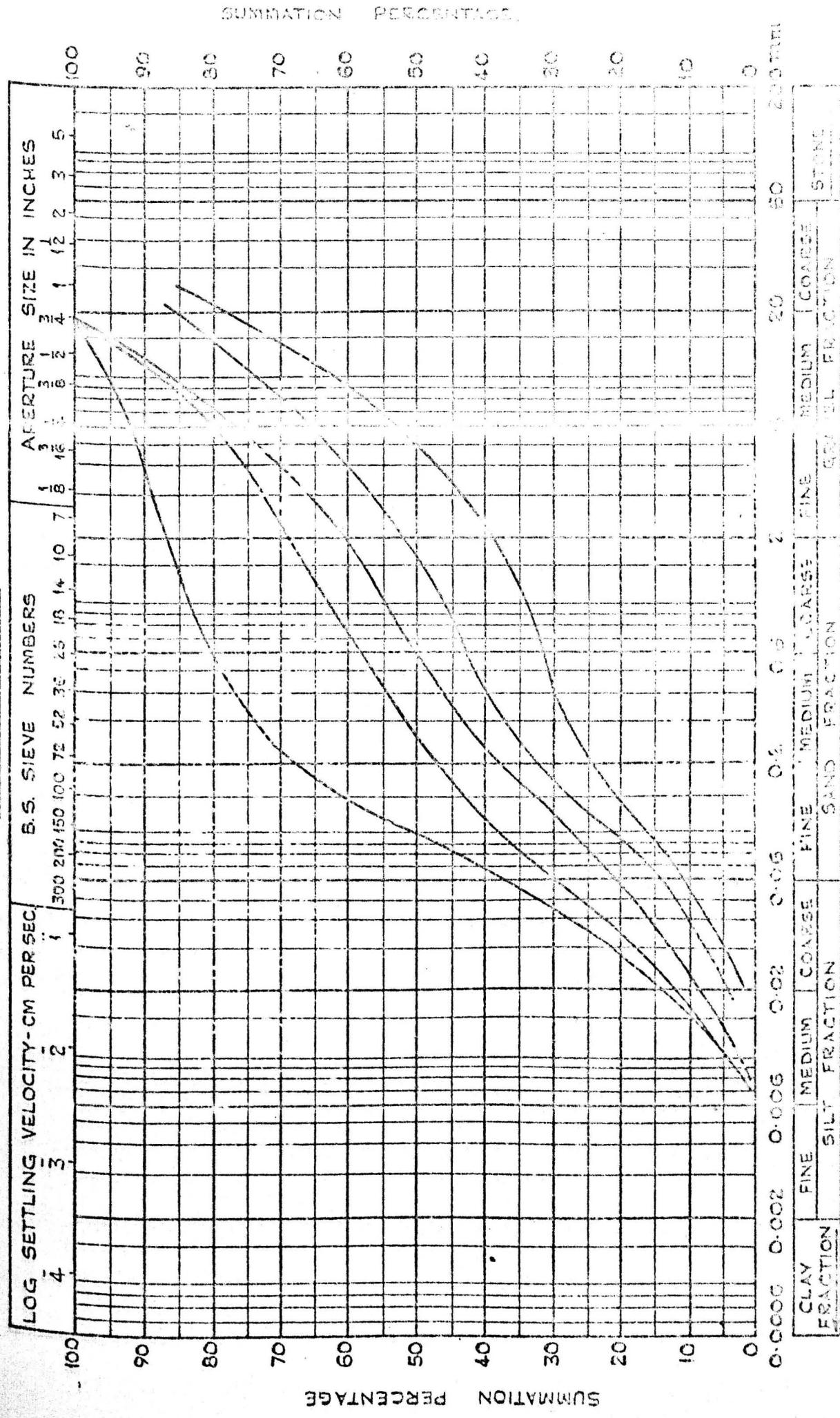
PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT



## PARTICLE SIZE DISTRIBUTION

### SEMI-LOG PLOT



PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT



FIG. 5a. SIZE DISTRIBUTIONS FOR LAGUNA DEL TUYU.

PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT

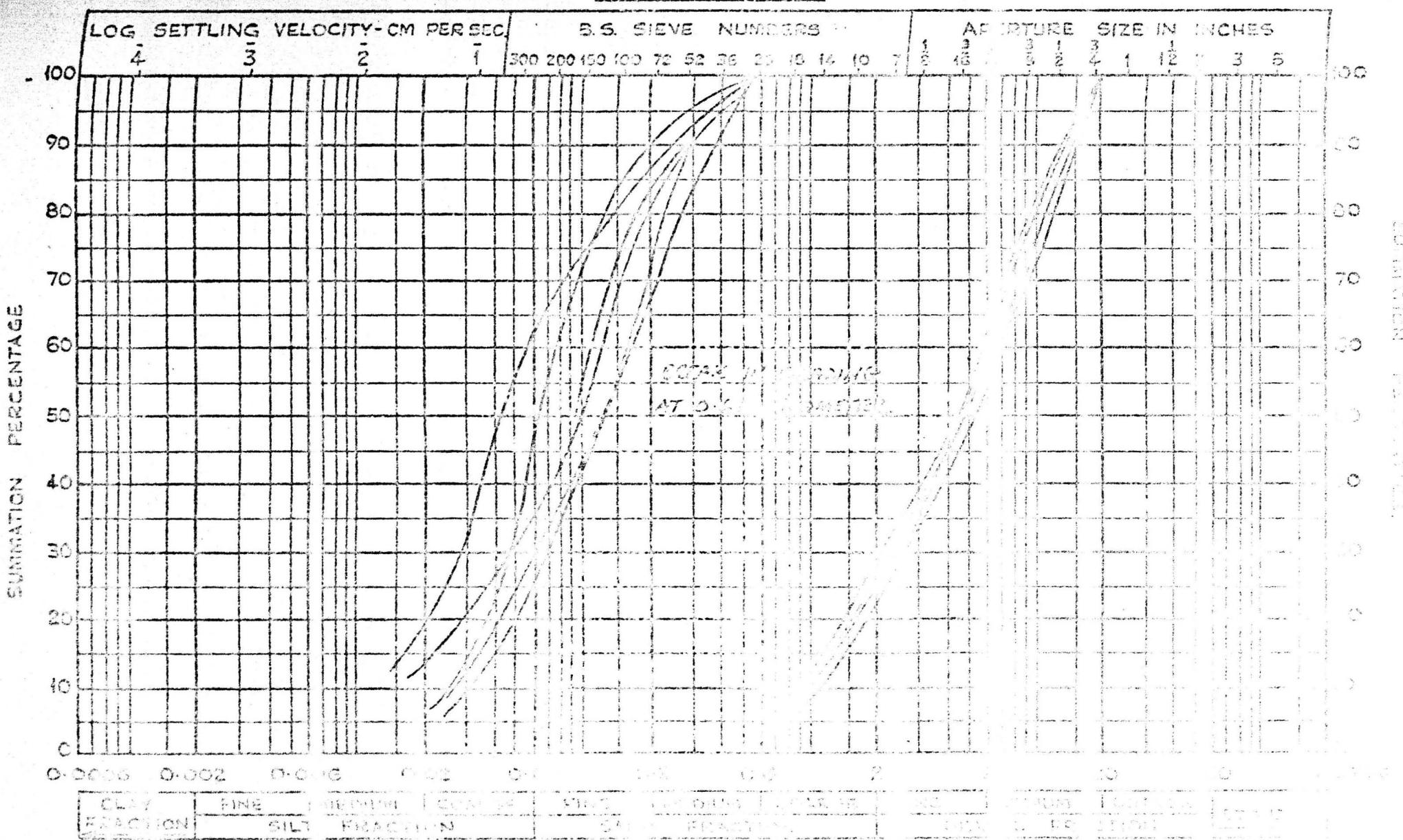


FIG. 5-11. SIZE OF ACTIVATED SLUDGE PARTICLES



SENTRY LOG PLOT

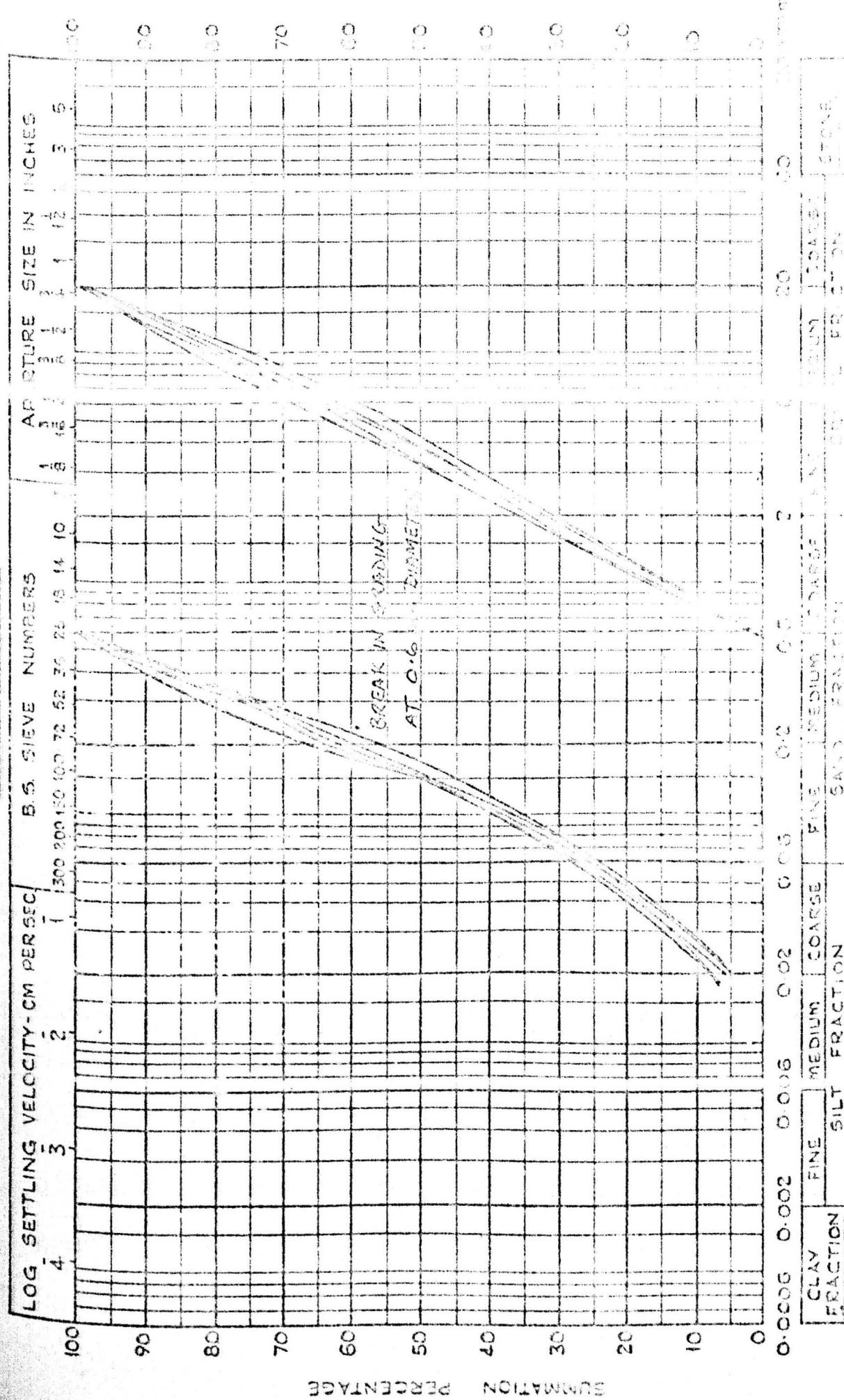


FIG. 5.23. SIZE FRACTIONS FOR CLEAN KINETIC CLAY.

PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT

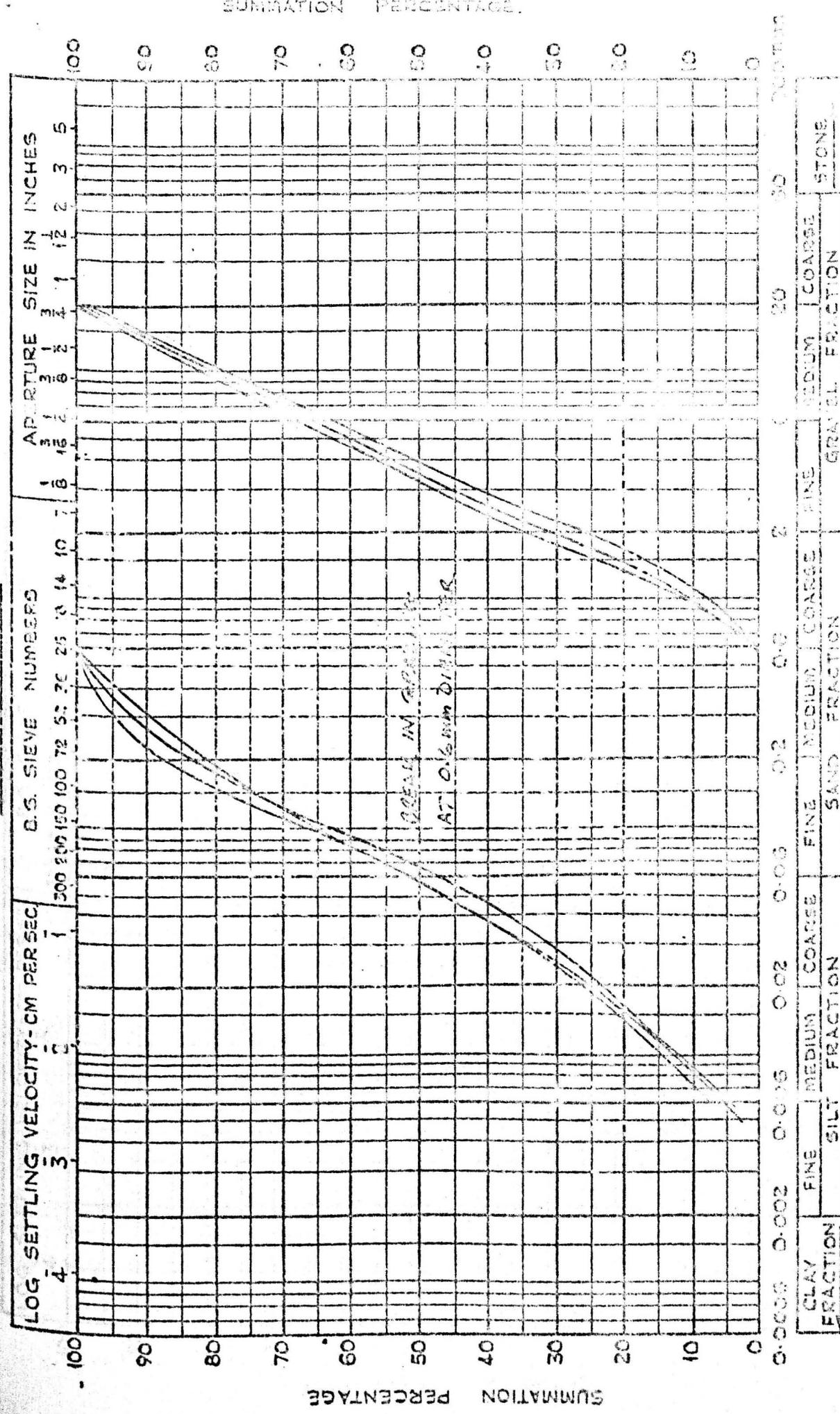


FIG. 5.21 SIZE FRACTION FOR STRATHLACHLAN TILL

PARTICLE SIZE DISTRIBUTION

SEMI - LOG PLOT

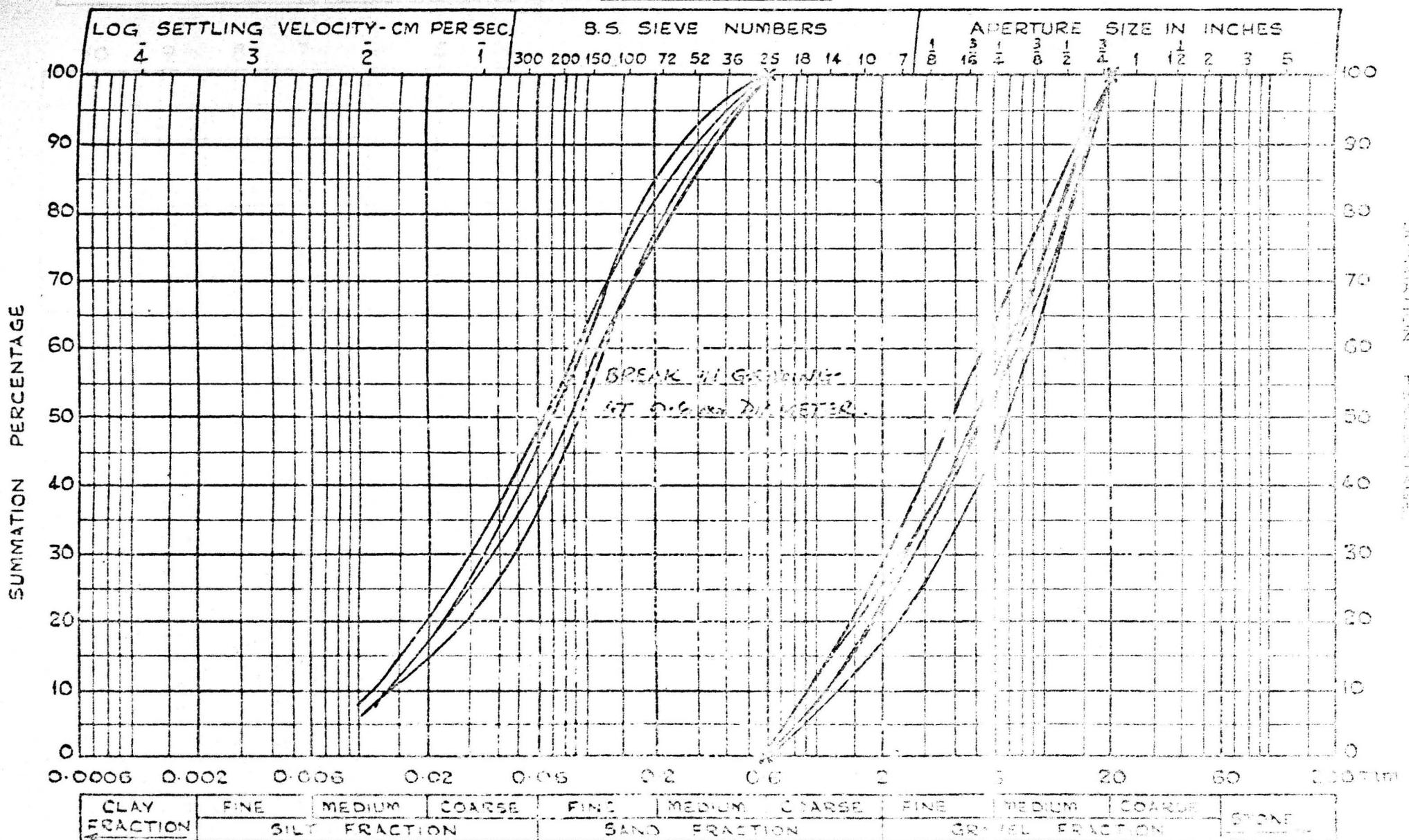


FIG. 5-25. SIZE FRACTIONS FOR DUNNING TILL.

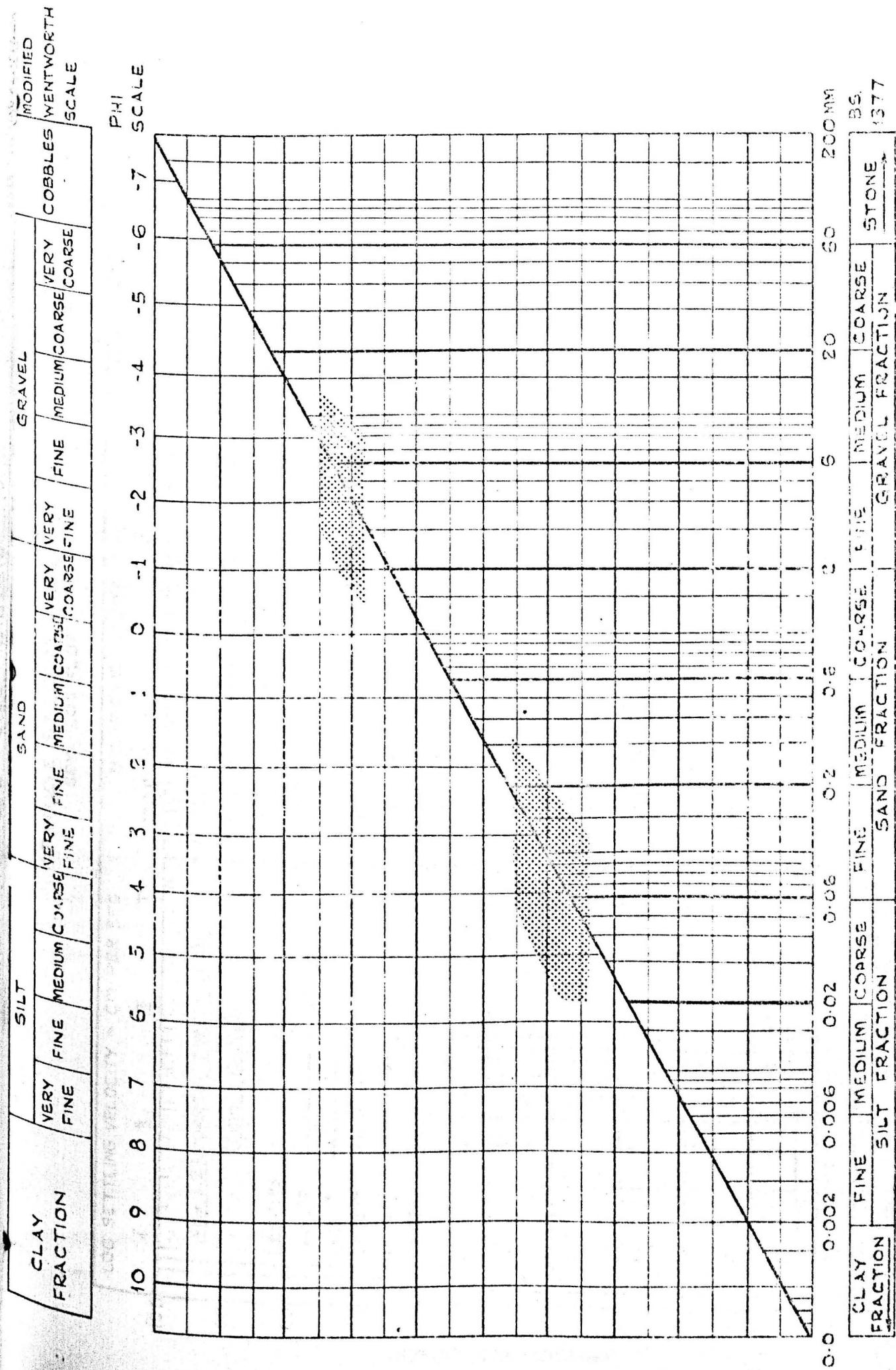
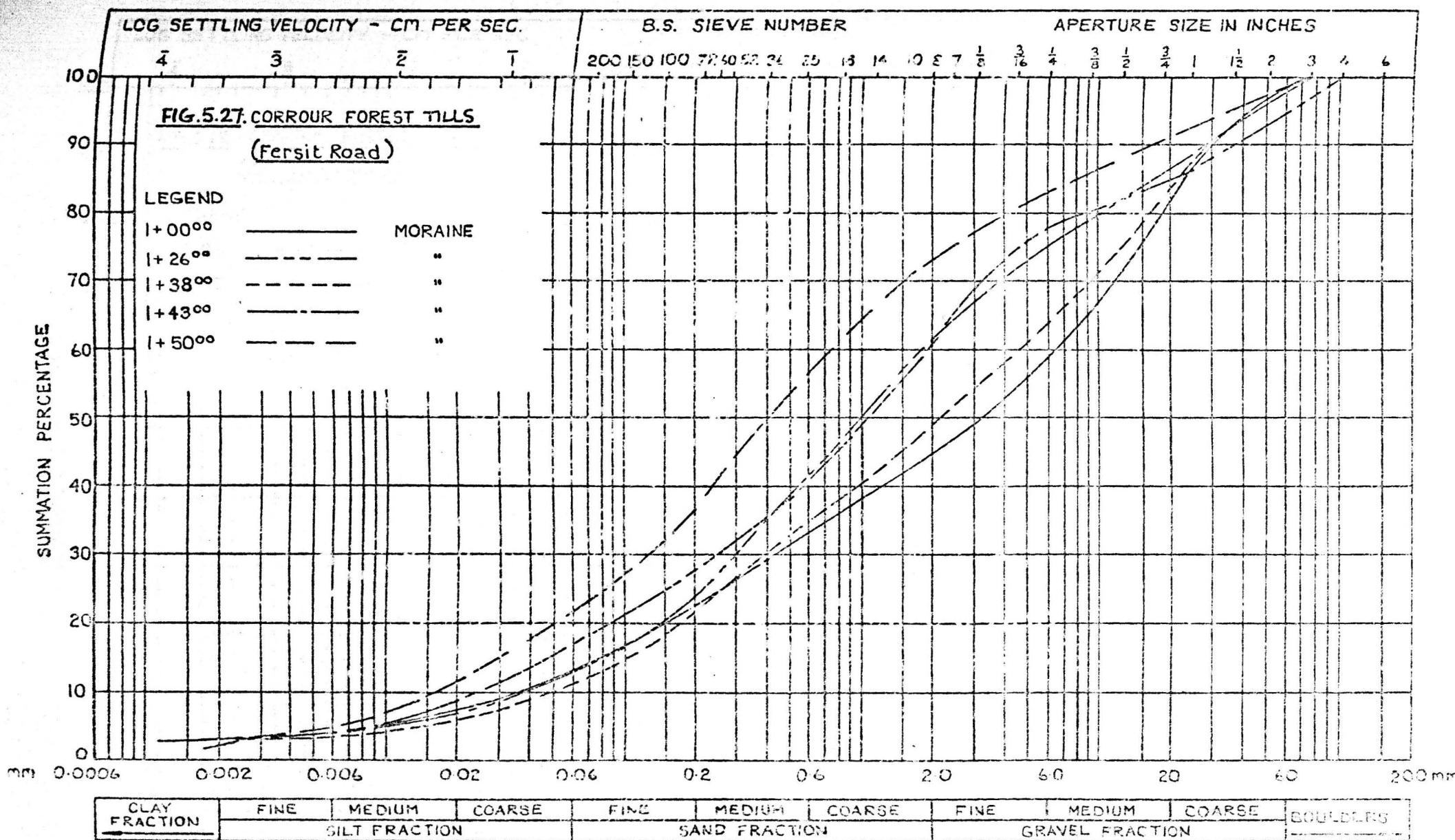


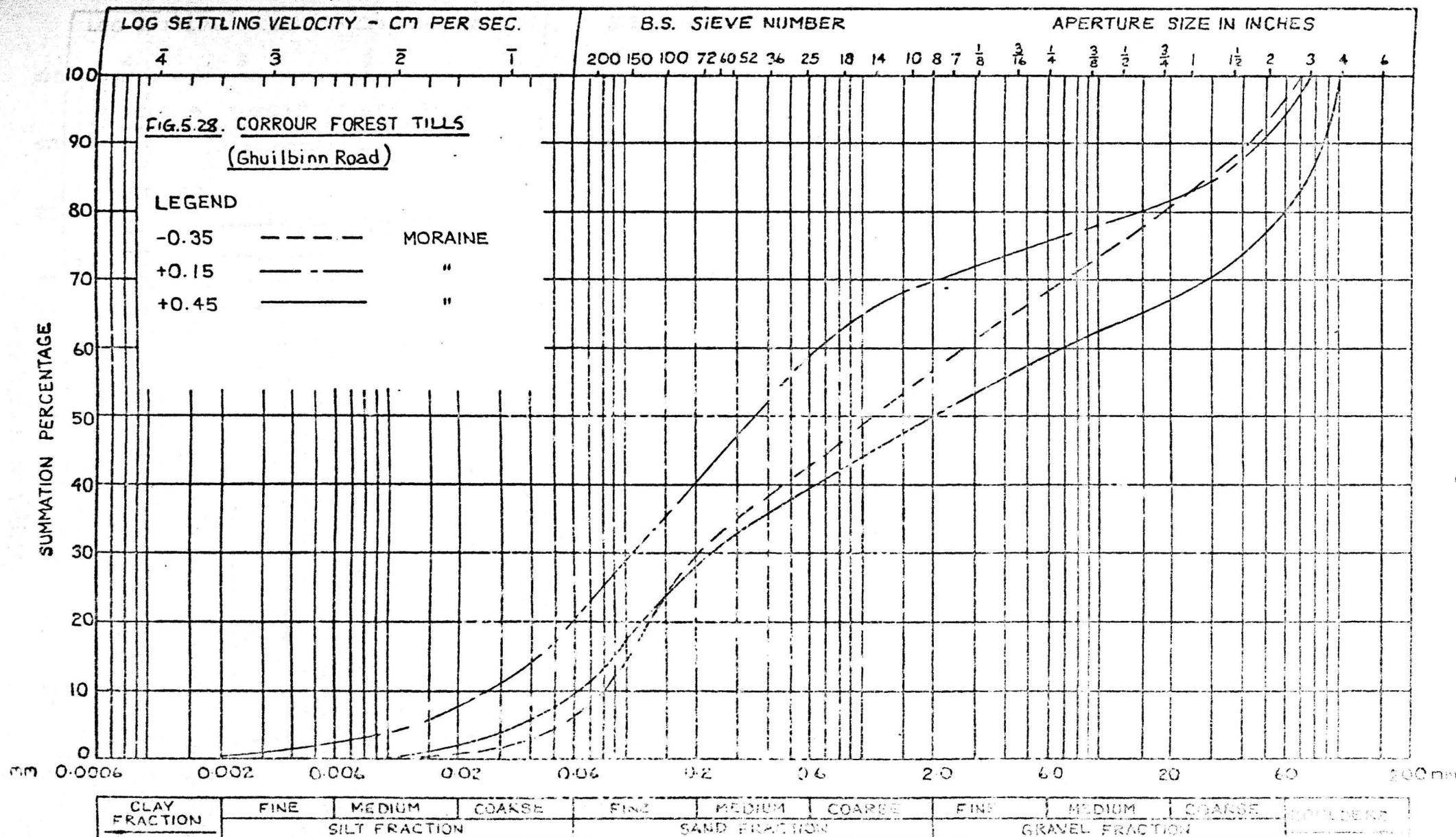
FIG. 5.26. TEXTURAL CLASSIFICATION BASED ON GRANULARITY AND COHESION

PARTICLE SIZE DISTRIBUTION

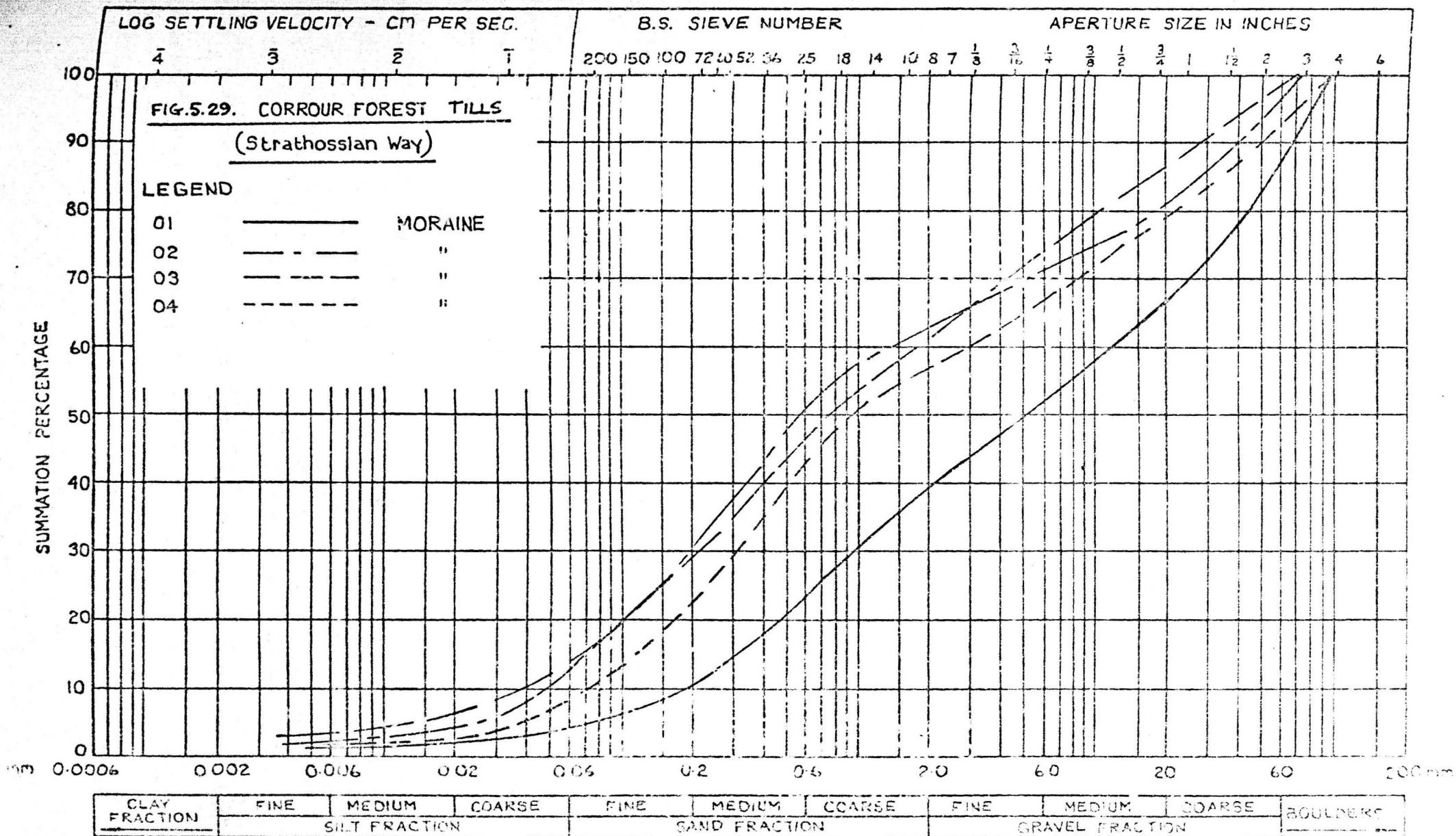
SEMI-LOG PLOT



PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

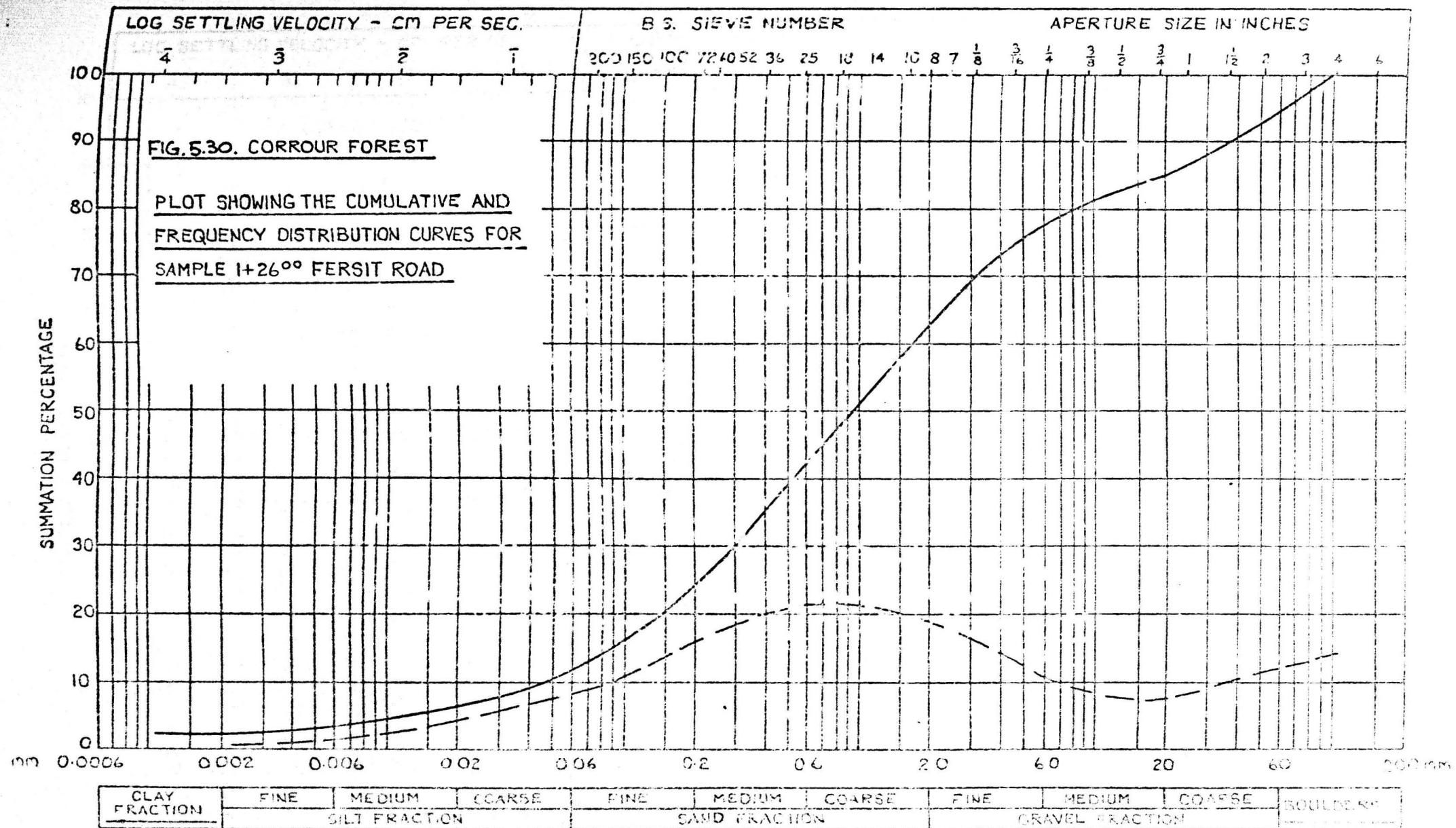


PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT



CLAY FRACTION	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT



PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

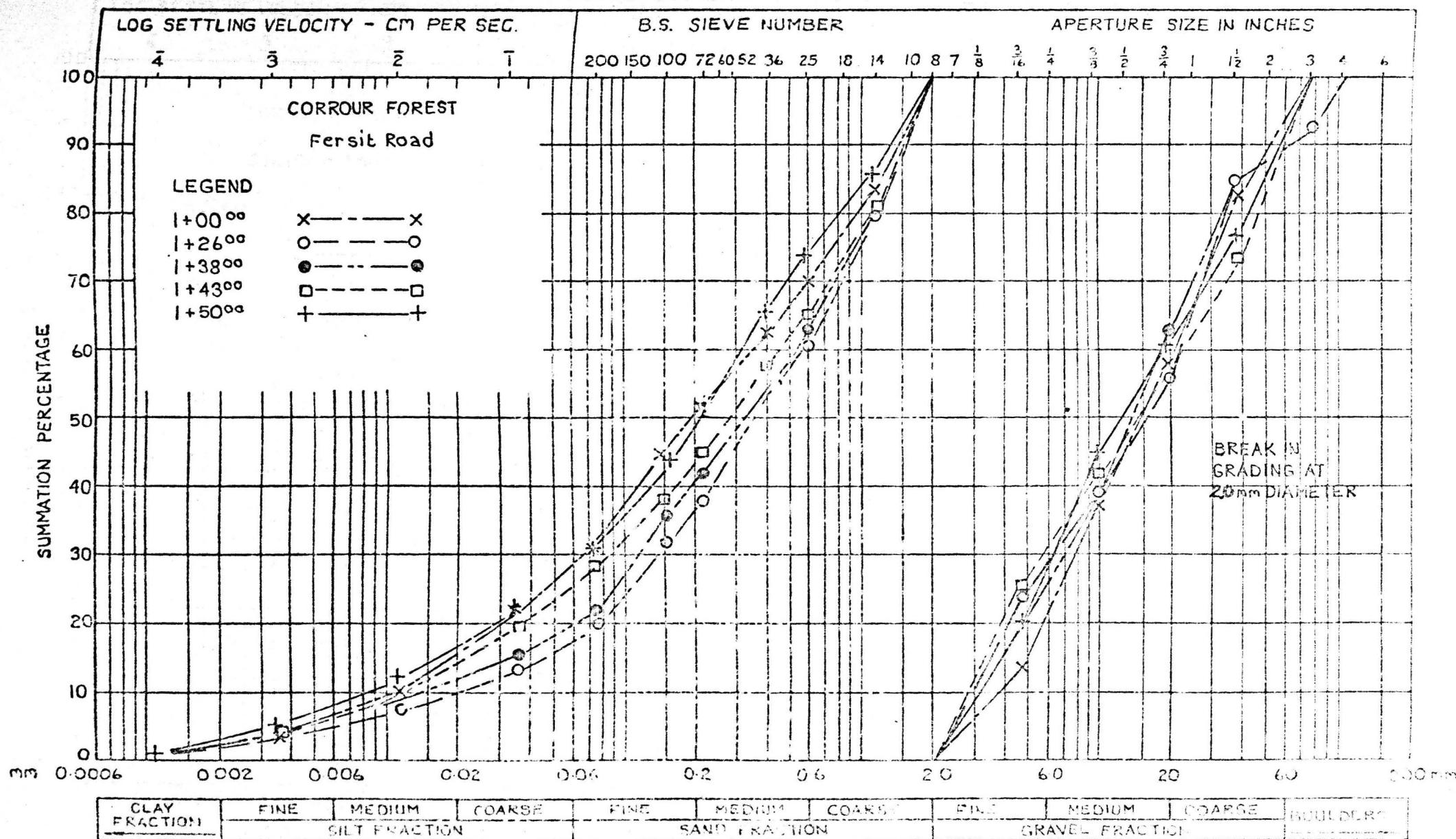


FIG. 5.31 SIZE FRACTIONS FOR CORROUR TILLS (FERSIT ROAD)

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

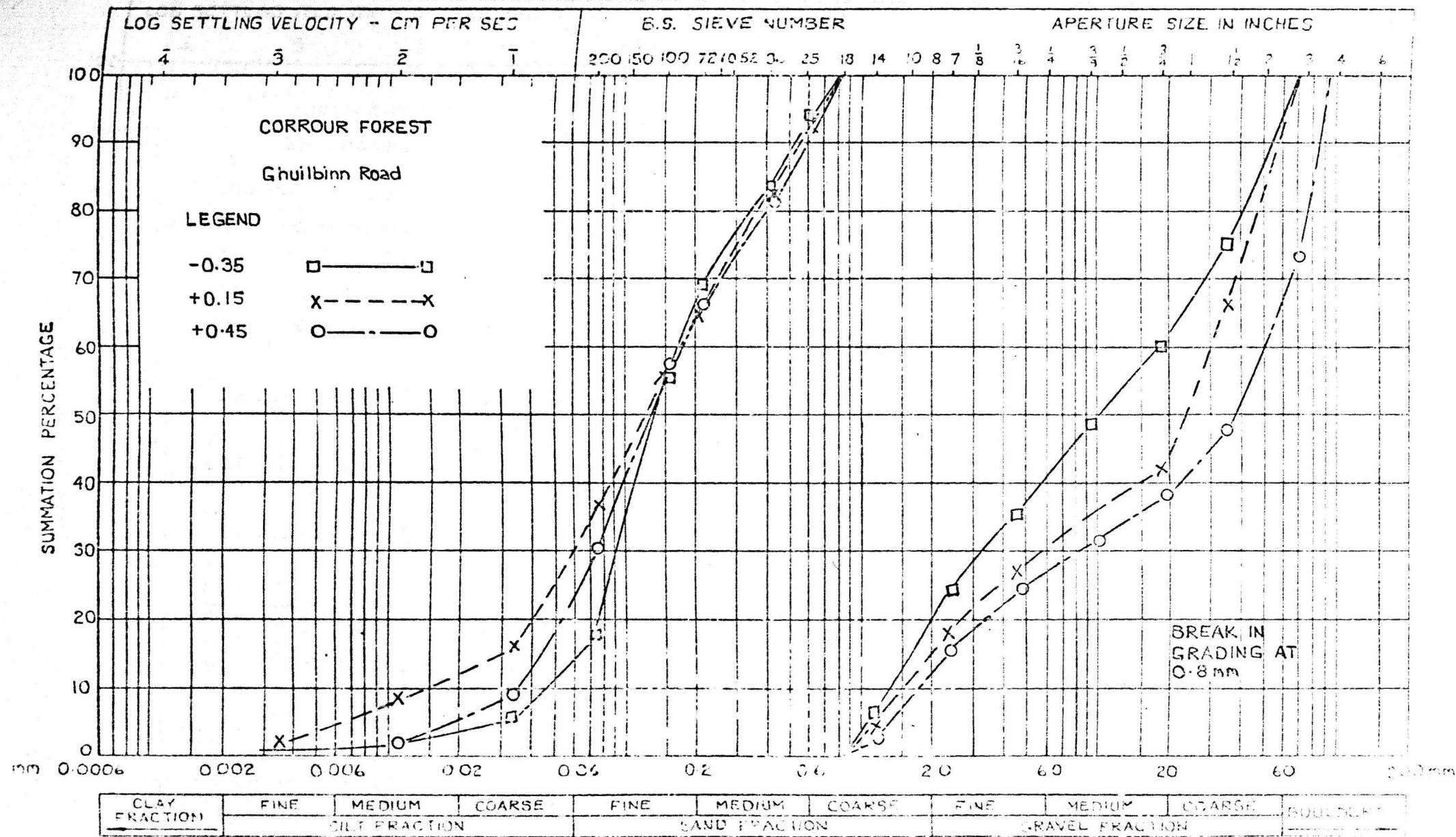


FIG. 5.32 SIZE FRACTIONS FOR CIRRULAR TILL (CIRCUIT ROAD)

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

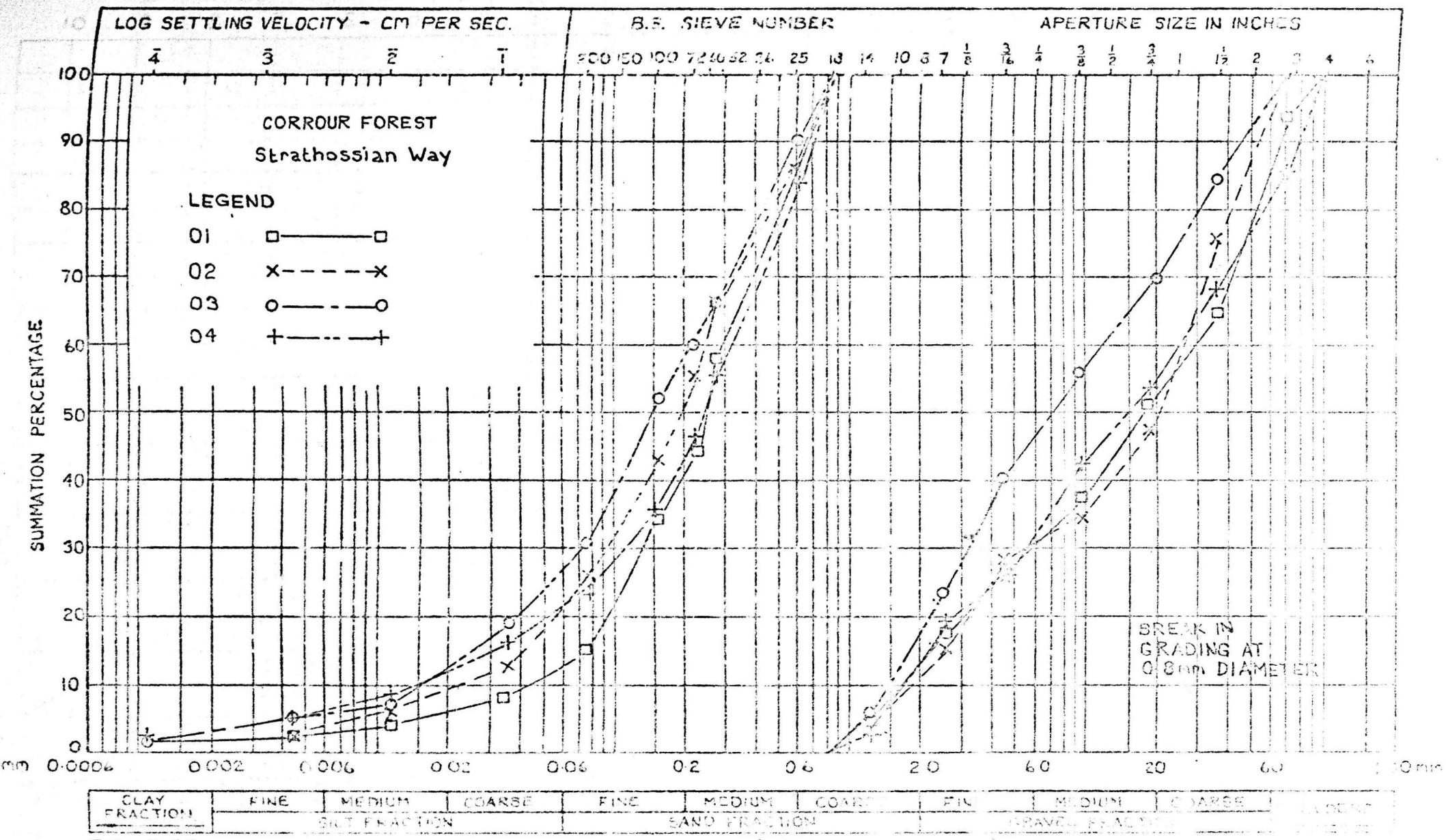


FIG. 5.33. SIZE FRACTIONS FOR CORROUR TILL (STRATHGEAN W.R.).

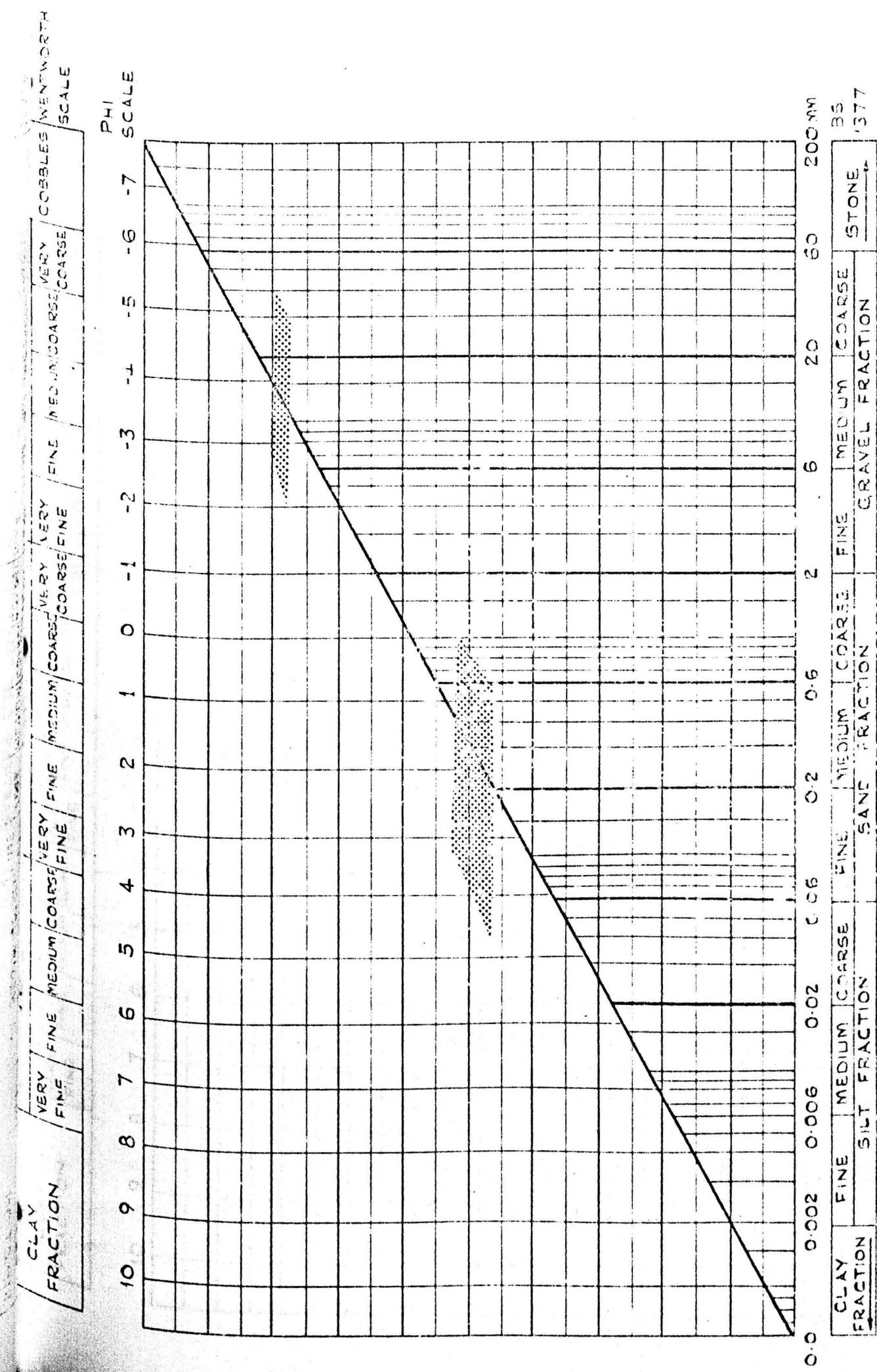


FIG. 5.34. TEXTURAL CLASSIFICATION BASED ON CORROSION TILES (FERTIL READ)

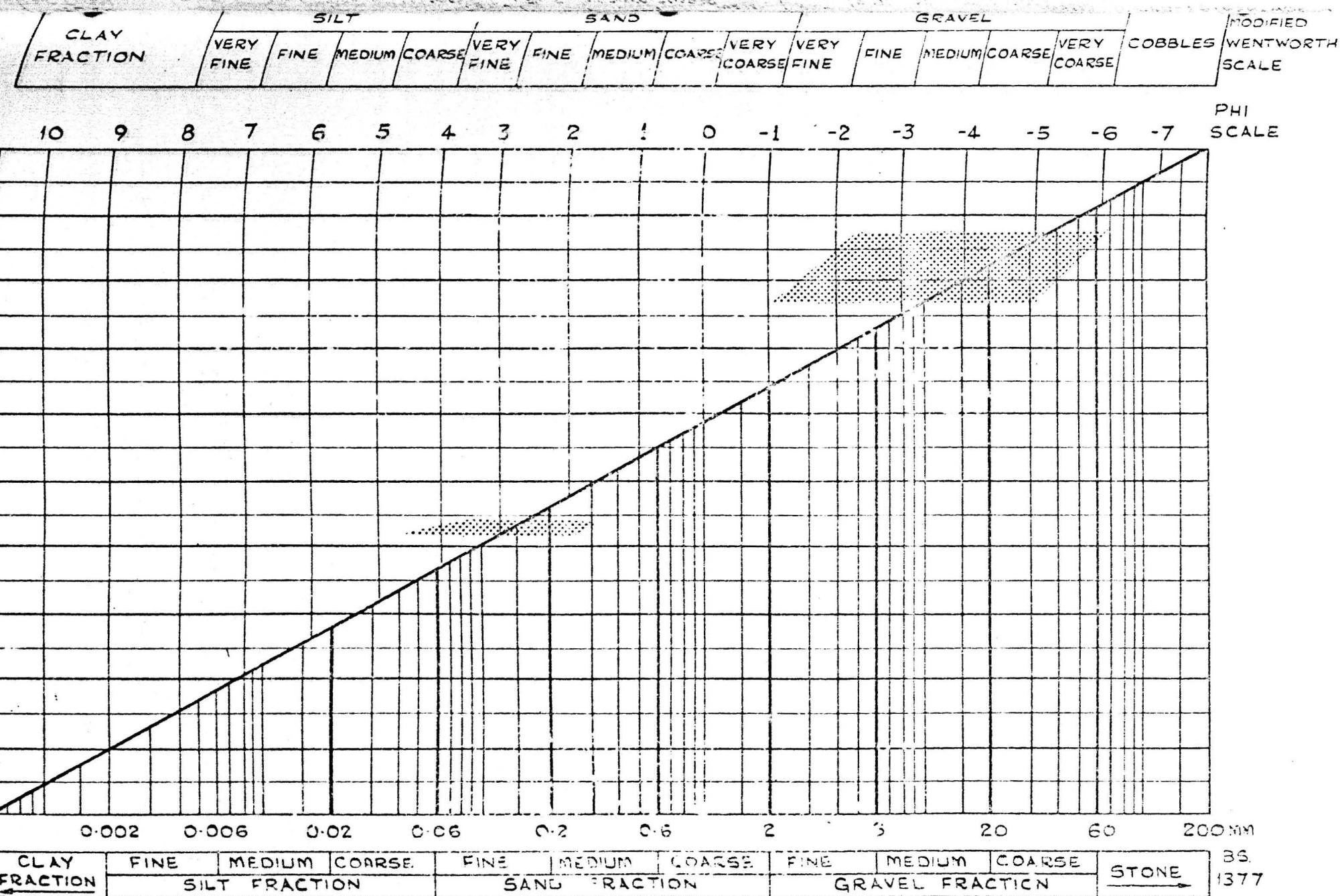
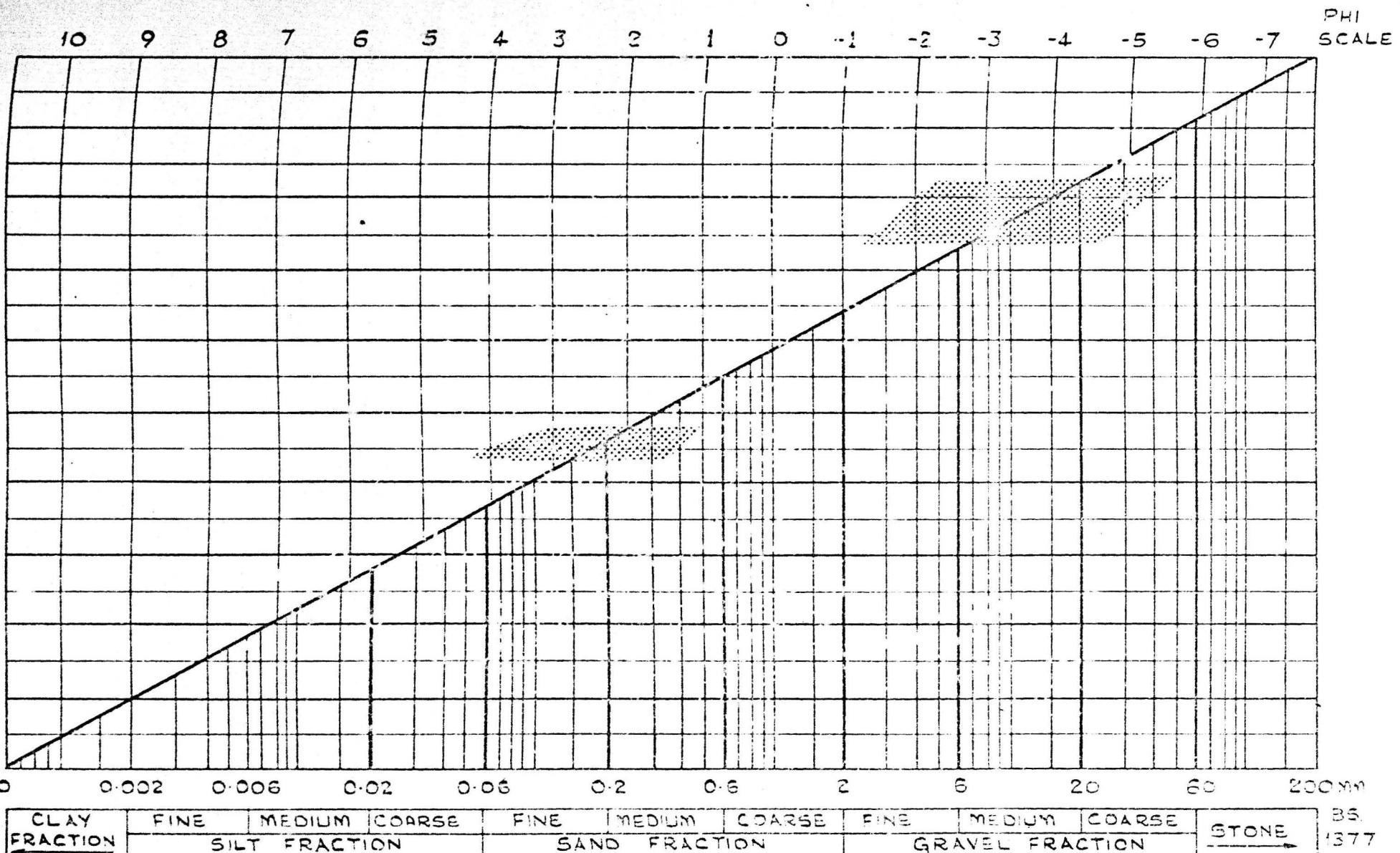


FIG. 3.35. TEXTURAL CLASSIFICATION BASED ON  $Q_1$ ,  $M_d$ ,  $Q_3$  FOR GHULBIRN ROAD, Colleour.

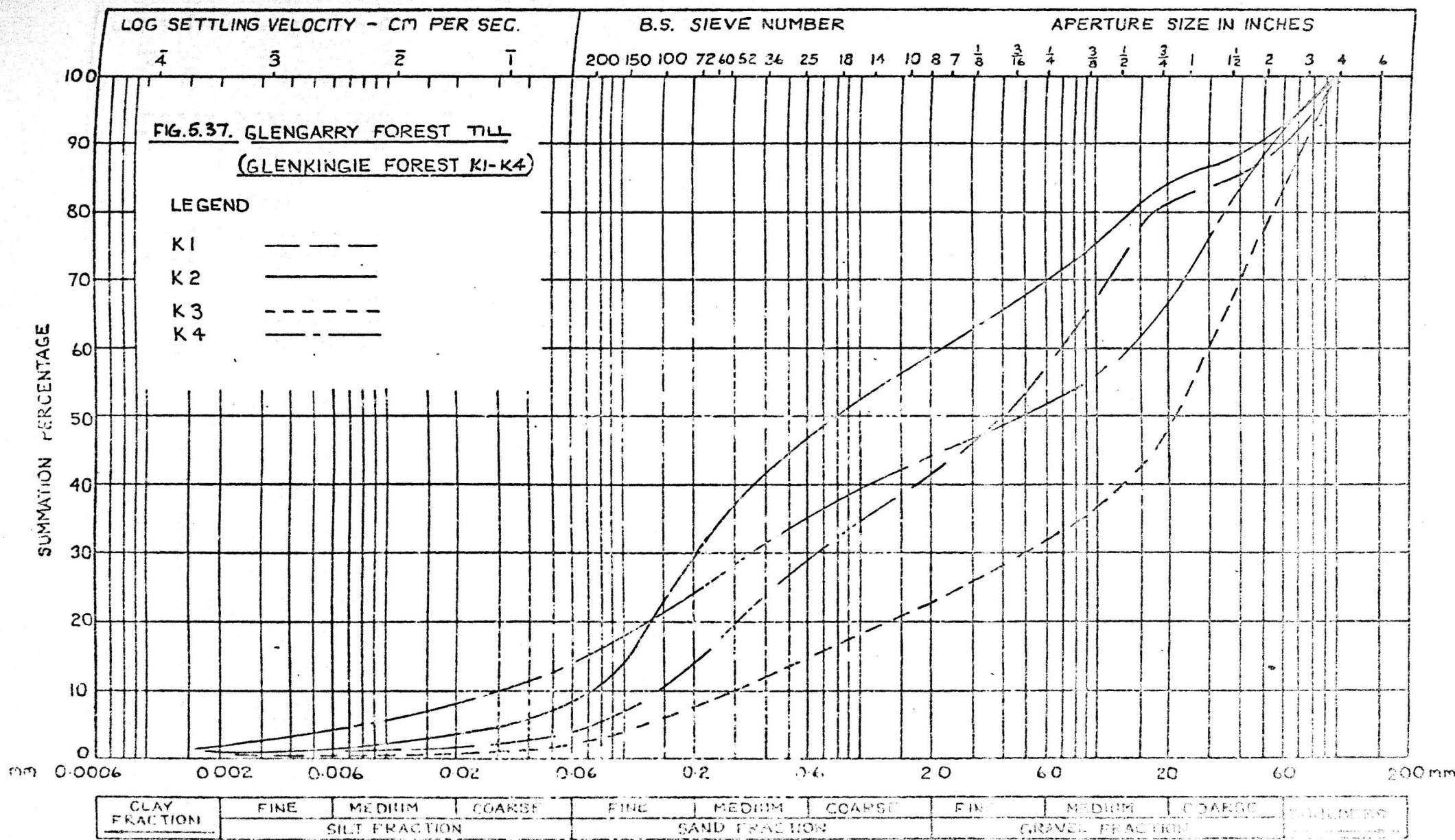
CLAY FRACTION	SILT			SAND			GRAVEL			MODIFIED WENTWORTH SCALE		
	VERY FINE	FINE	MEDIUM	COARSE	VERY FINE	FINE	MEDIUM	COARSE	VERY COARSE	FINE	MEDIUM	COARSE



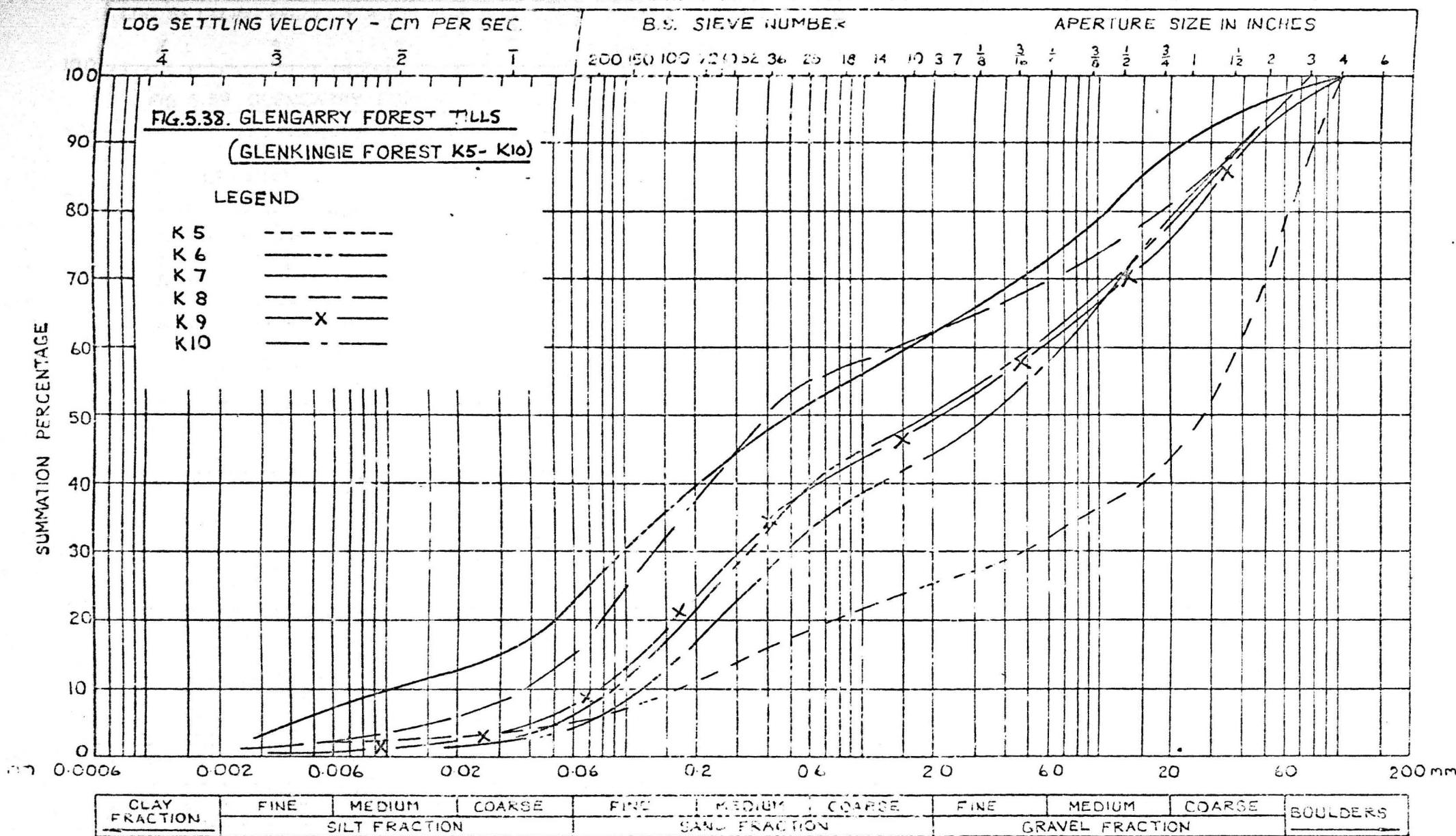
CLAY FRACTION	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	STONE
	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			1377

FIG. 5.36. TEXTURAL CLASSIFICATION BASED ON  $Q_1$ ,  $M_d$ ,  $Q_3$  FOR CORIOLIS FOREST (STRATHOSSIAN MAP)

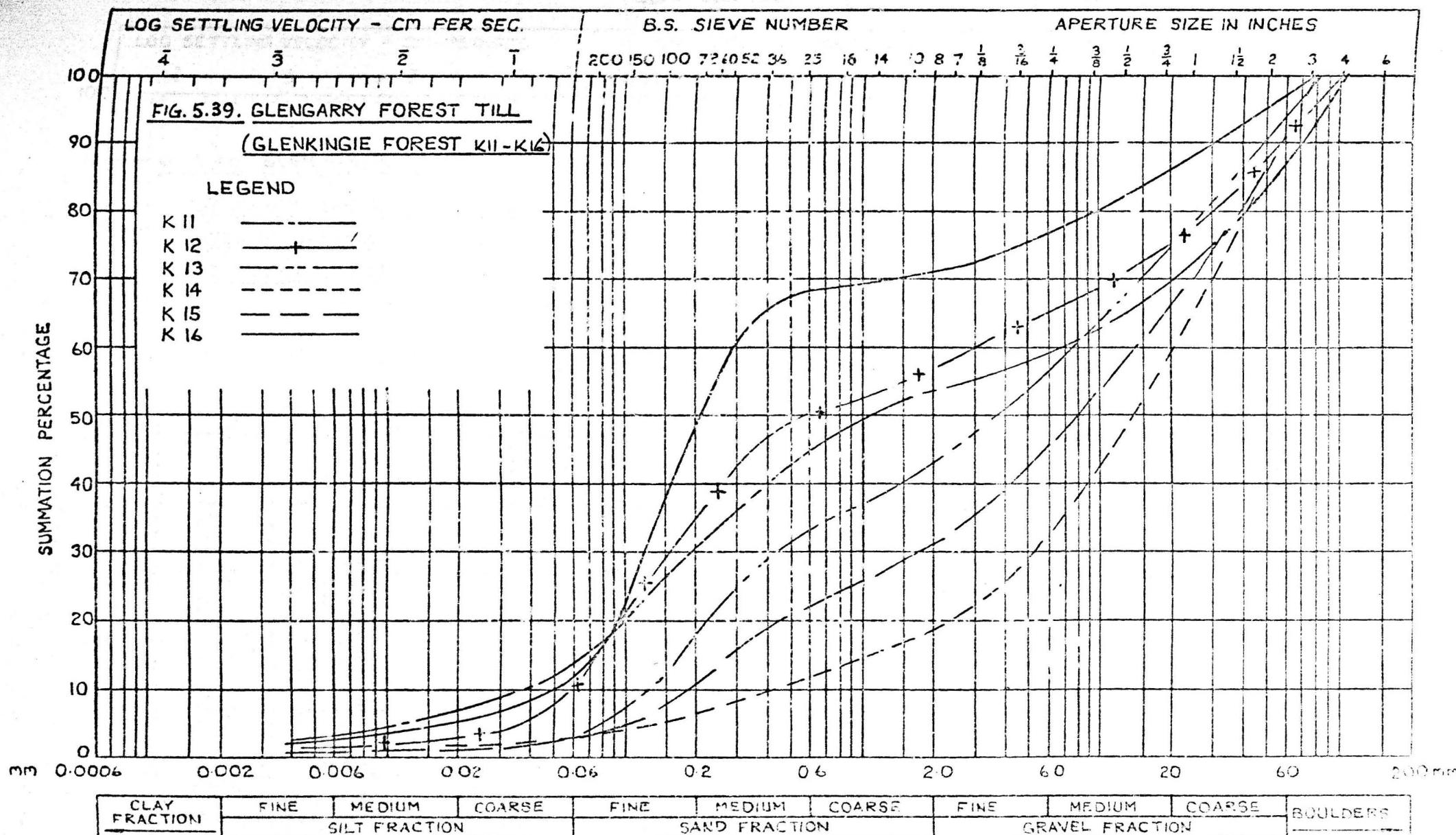
PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT



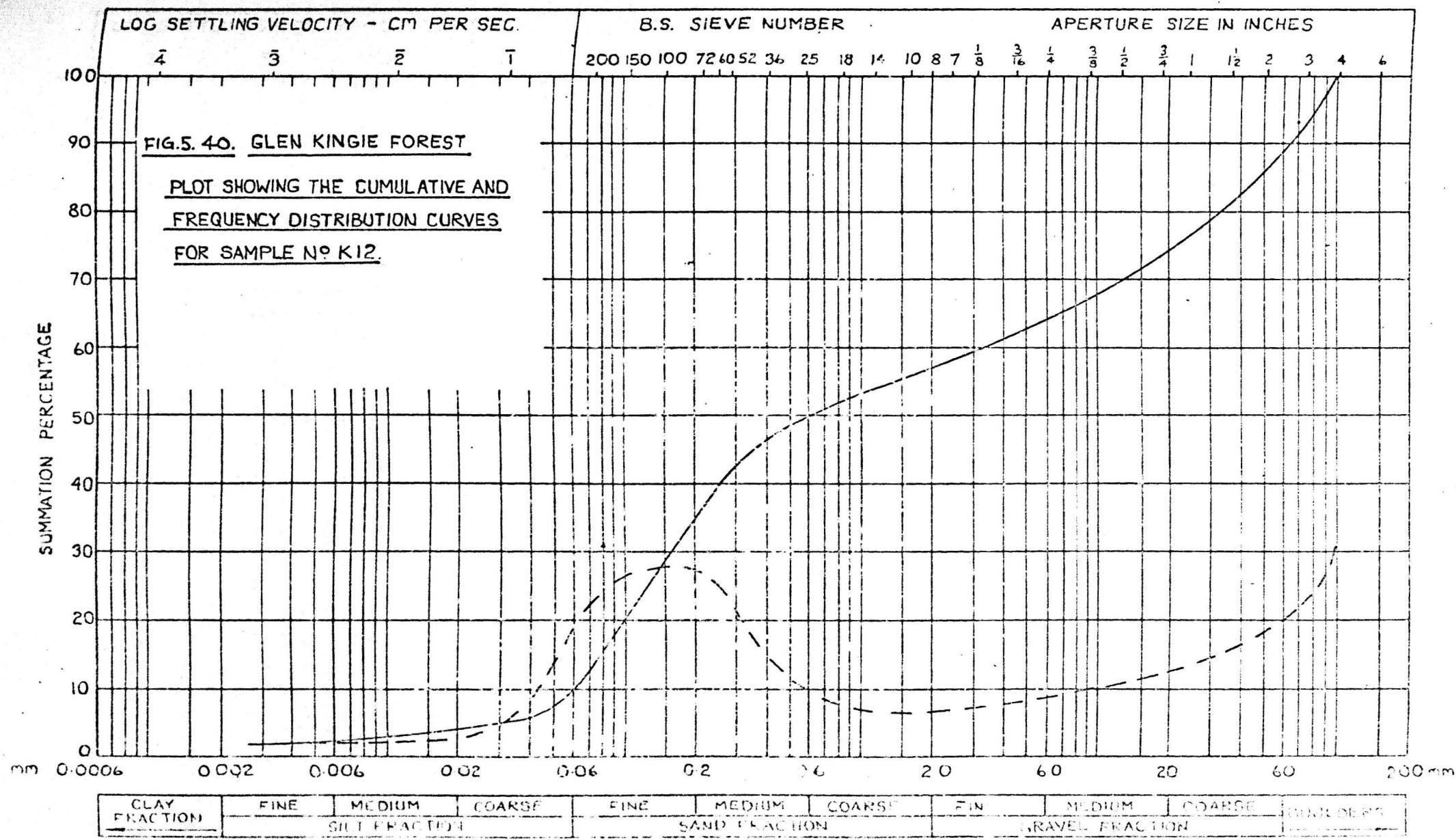
PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT



PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT



PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT



PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

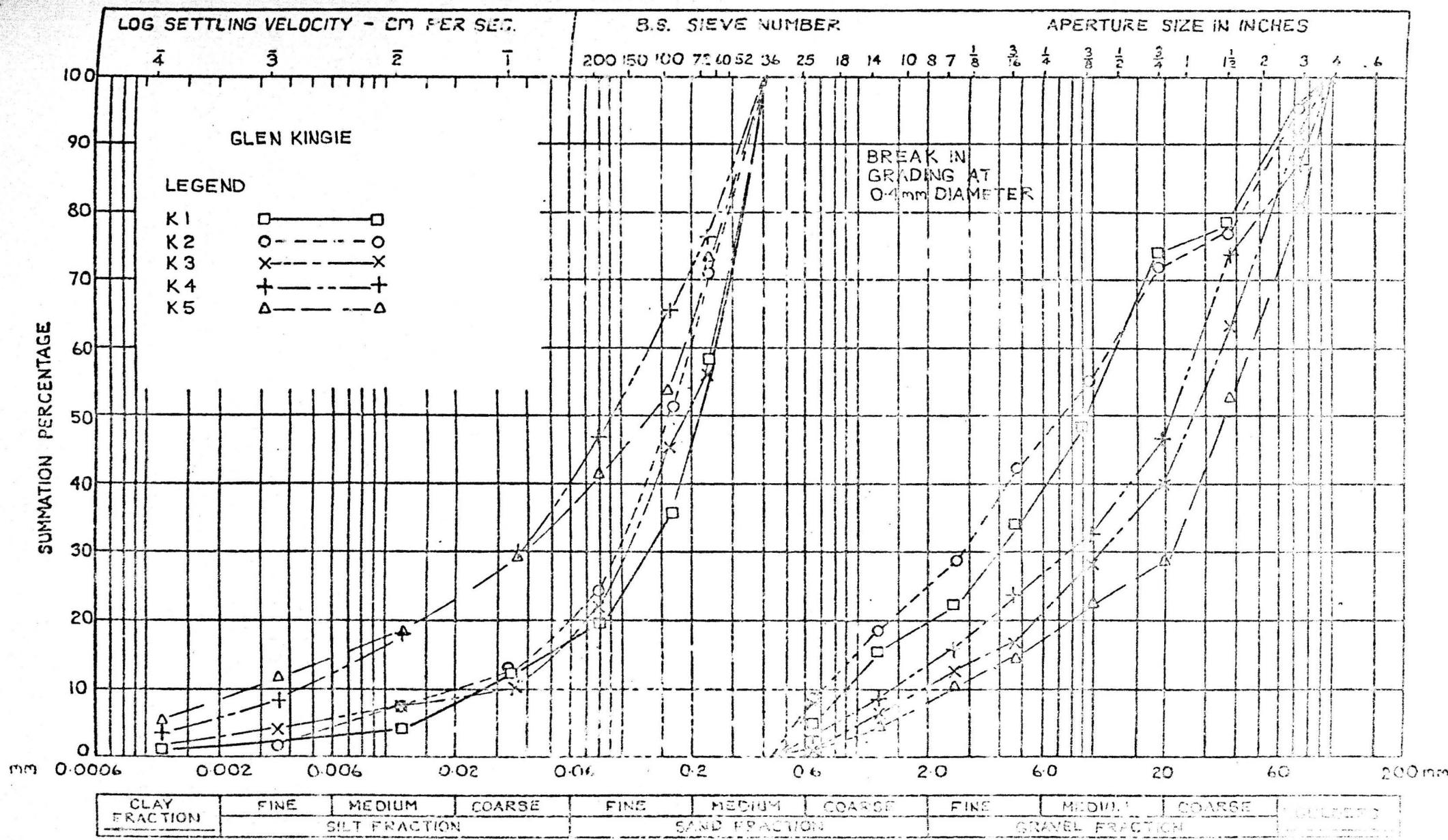


FIG. 5.41 SIZE FRACTIONS FOR GLEN KINGIE TURF 11-1 KET.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

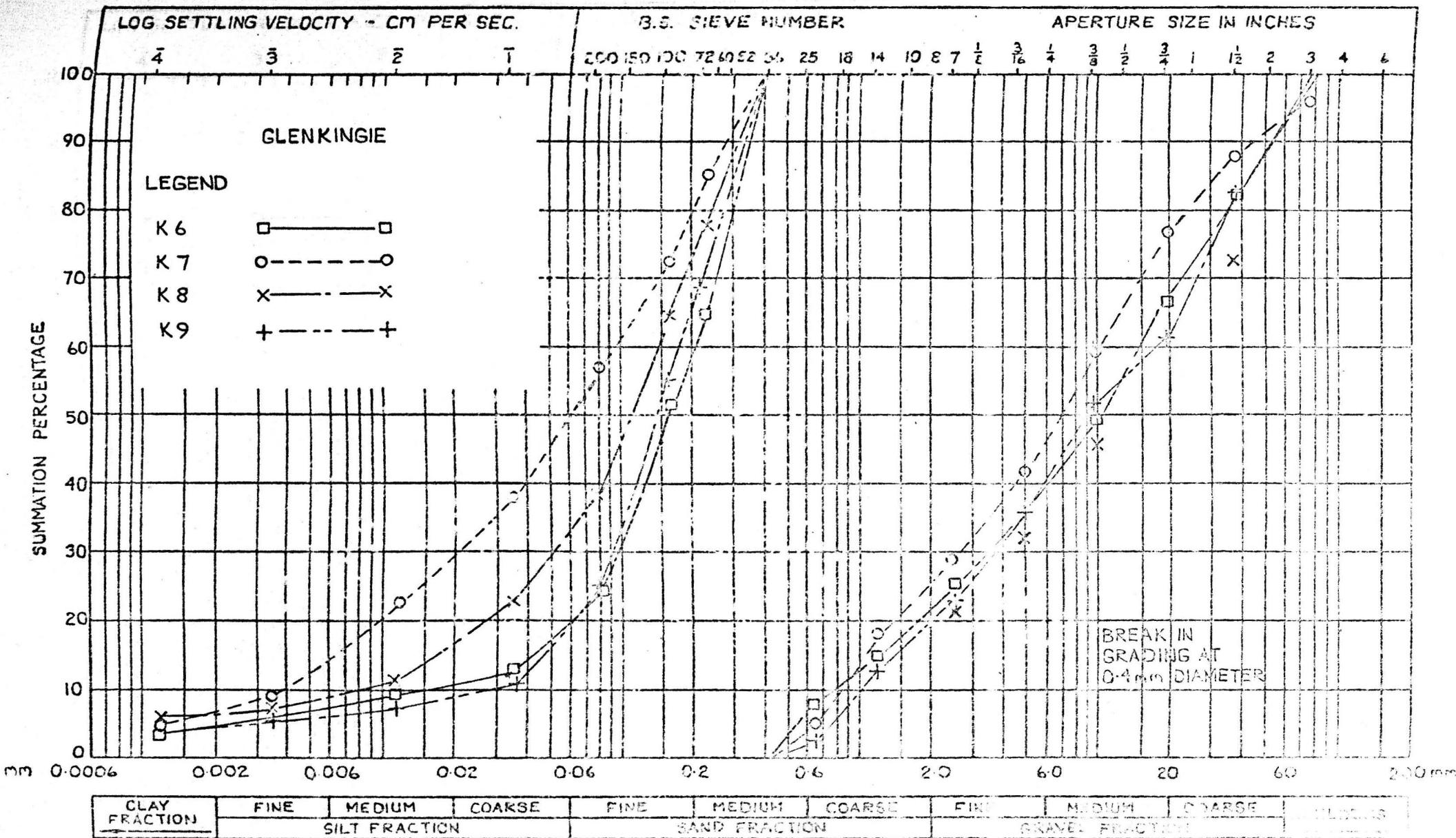


FIG. 5.42 SIZE FRACTIONS FOR GLEN KINGIE TILLS K6-K9.

PARTICLE SIZE DISTRIBUTION  
SEMI-LCG PLOT

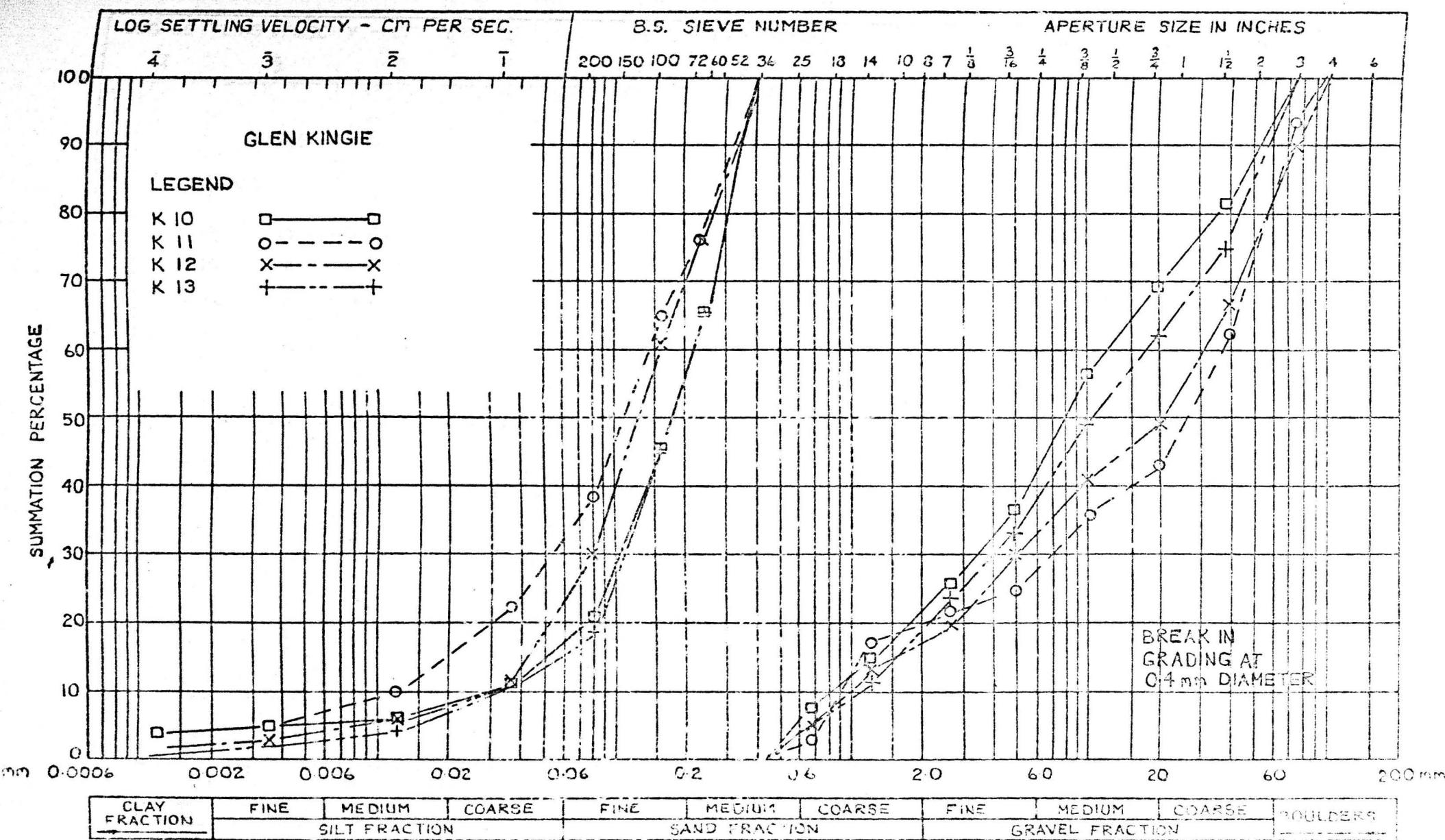


FIG. 5.43 SIZE FRACTIONS FOR GLEN KINGIE TILLS K10-K13.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

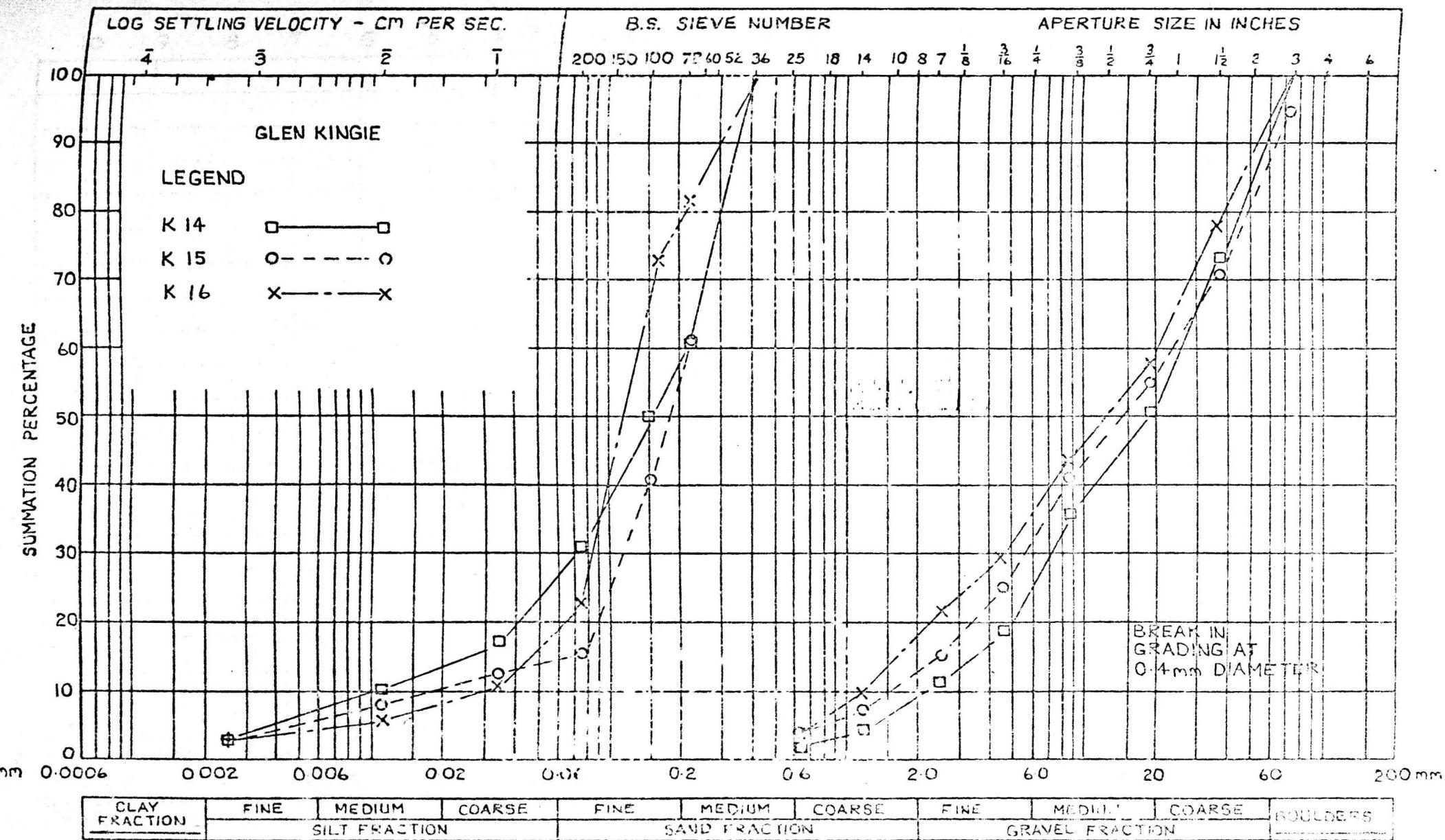


FIG. 5.44 SIZE FRACTION FOR GLEN KINGIE TILLS K14-K16.

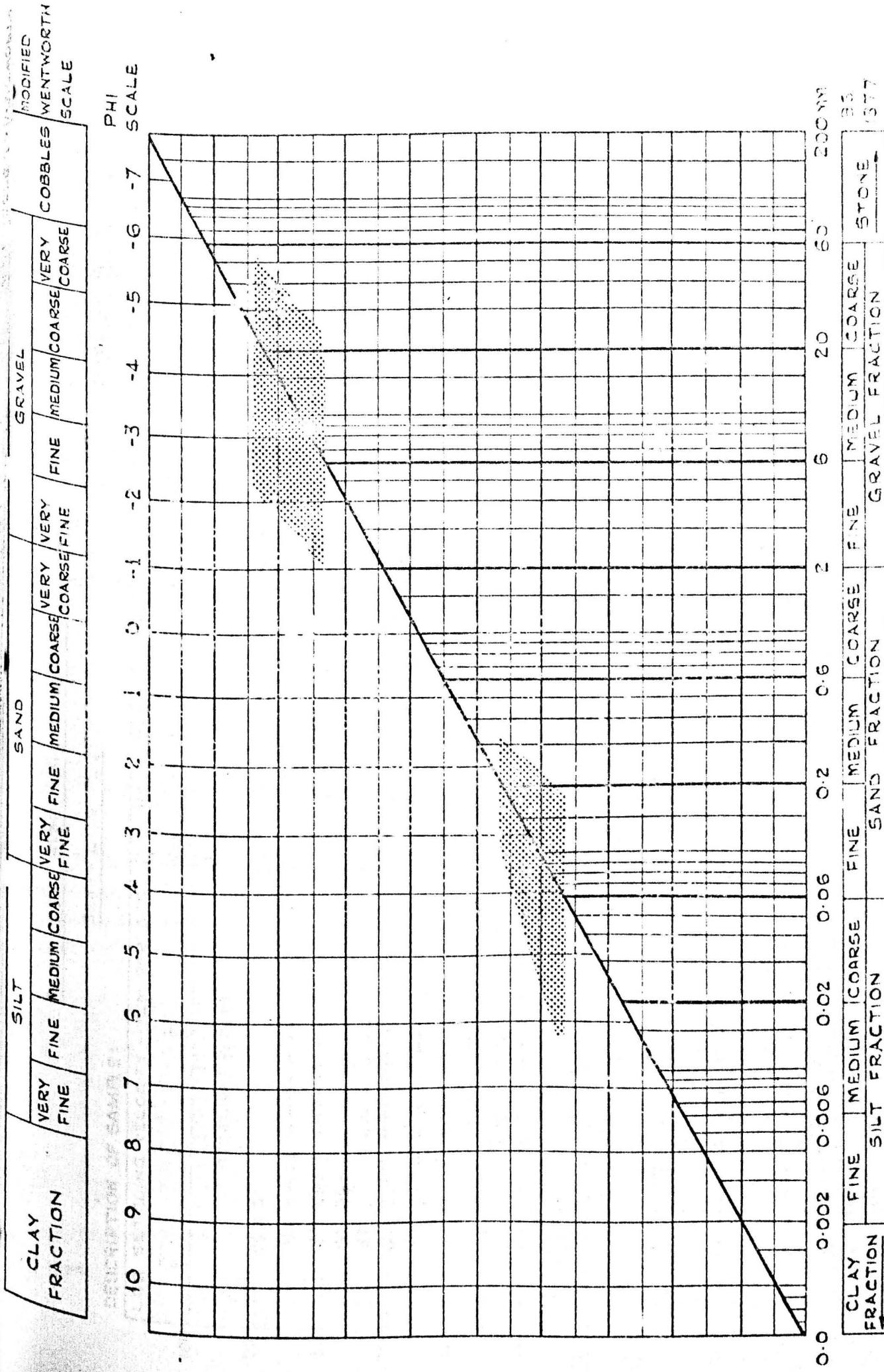


FIG. 5.45. TEXTURAL CLASSIFICATION BASED ON SOIL MORPHOLOGY

PARTICLE SIZE DISTRIBUTION

SEMI - LOG PLOT

DATE OF TEST :-

DESCRIPTION OF SAMPLE:-

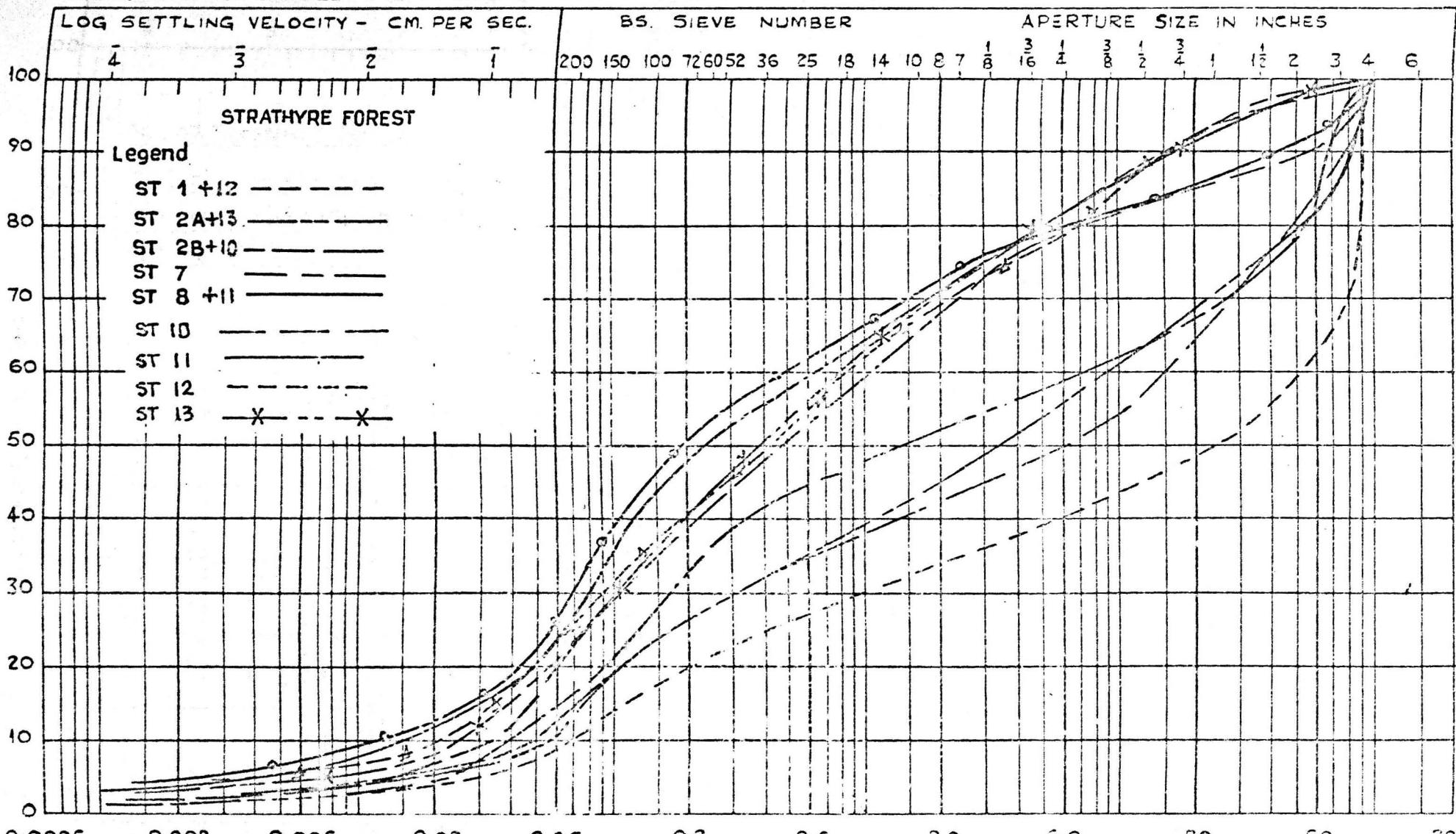
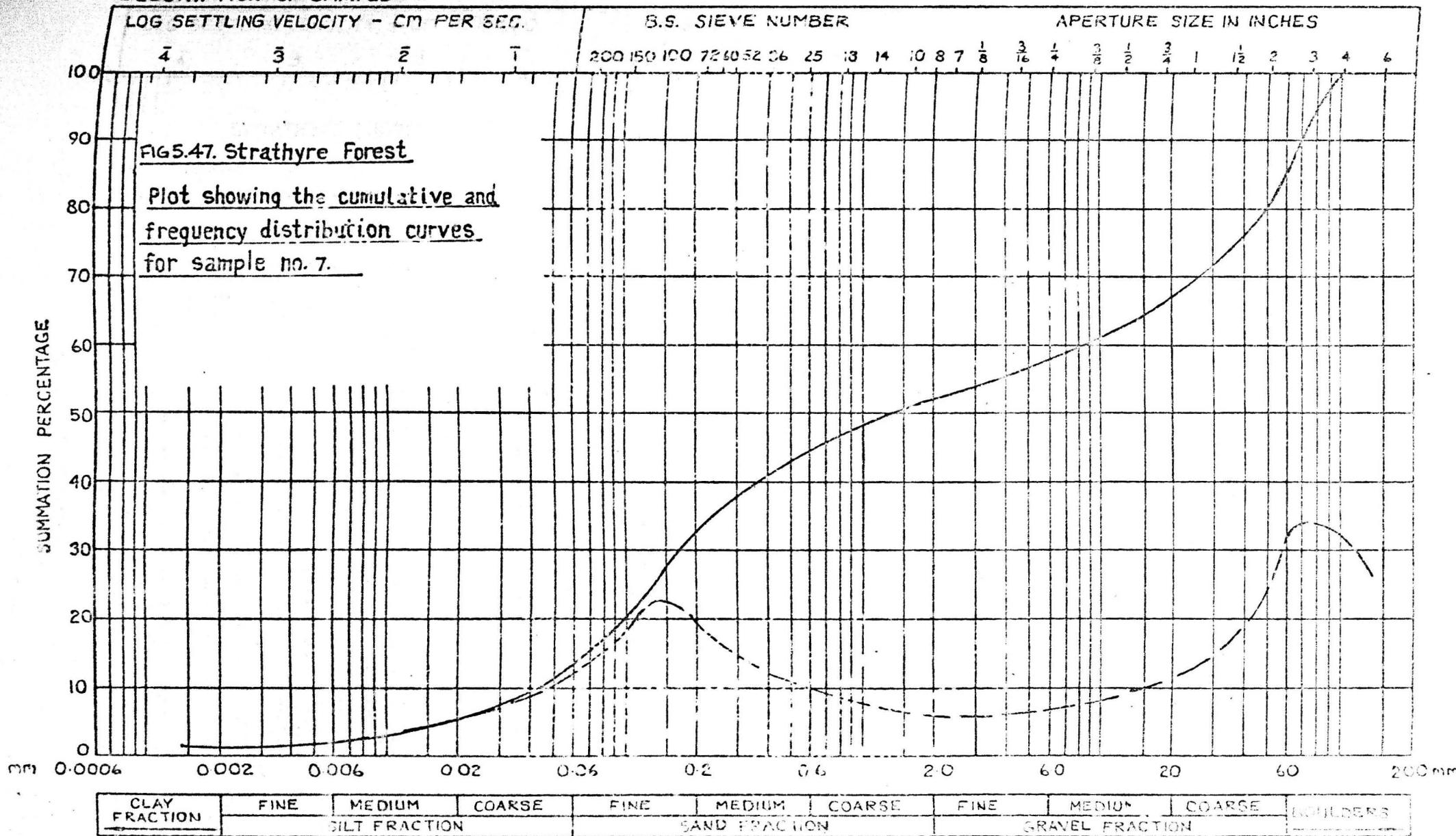


FIG. 5.46. GRADING 16K STRATHYRE TILLS.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

DATE OF TEST:-

**DESCRIPTION OF SAMPLE :-**



PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

DATE OF TEST :-

DESCRIPTION OF SAMPLE :-

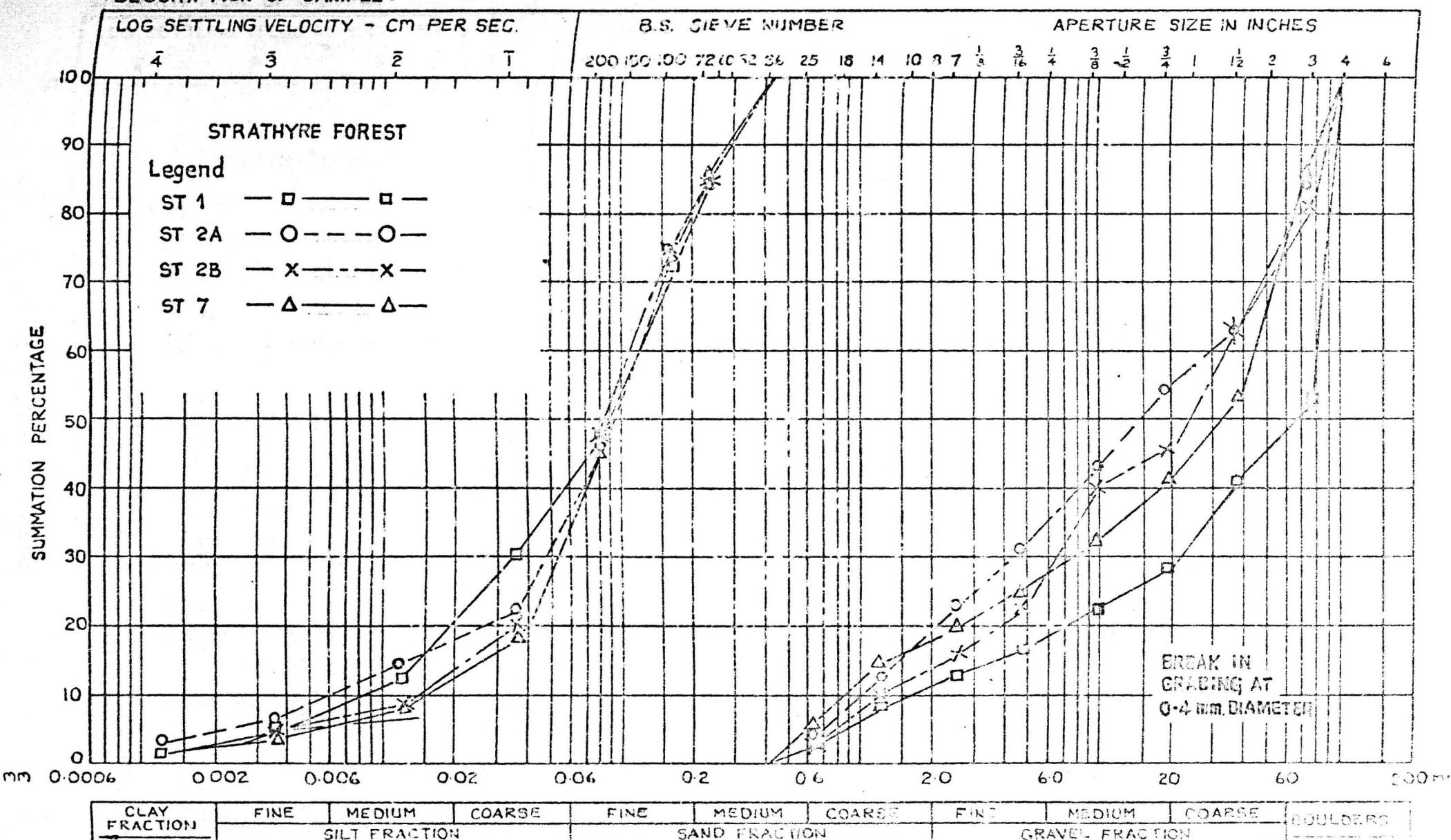


FIG. 5.48

SIZE FRACTIONS FOR STRATHYRE TILLS (ST1 - ST7)

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

DATE OF TEST:

**DESCRIPTION OF SAMPLE**

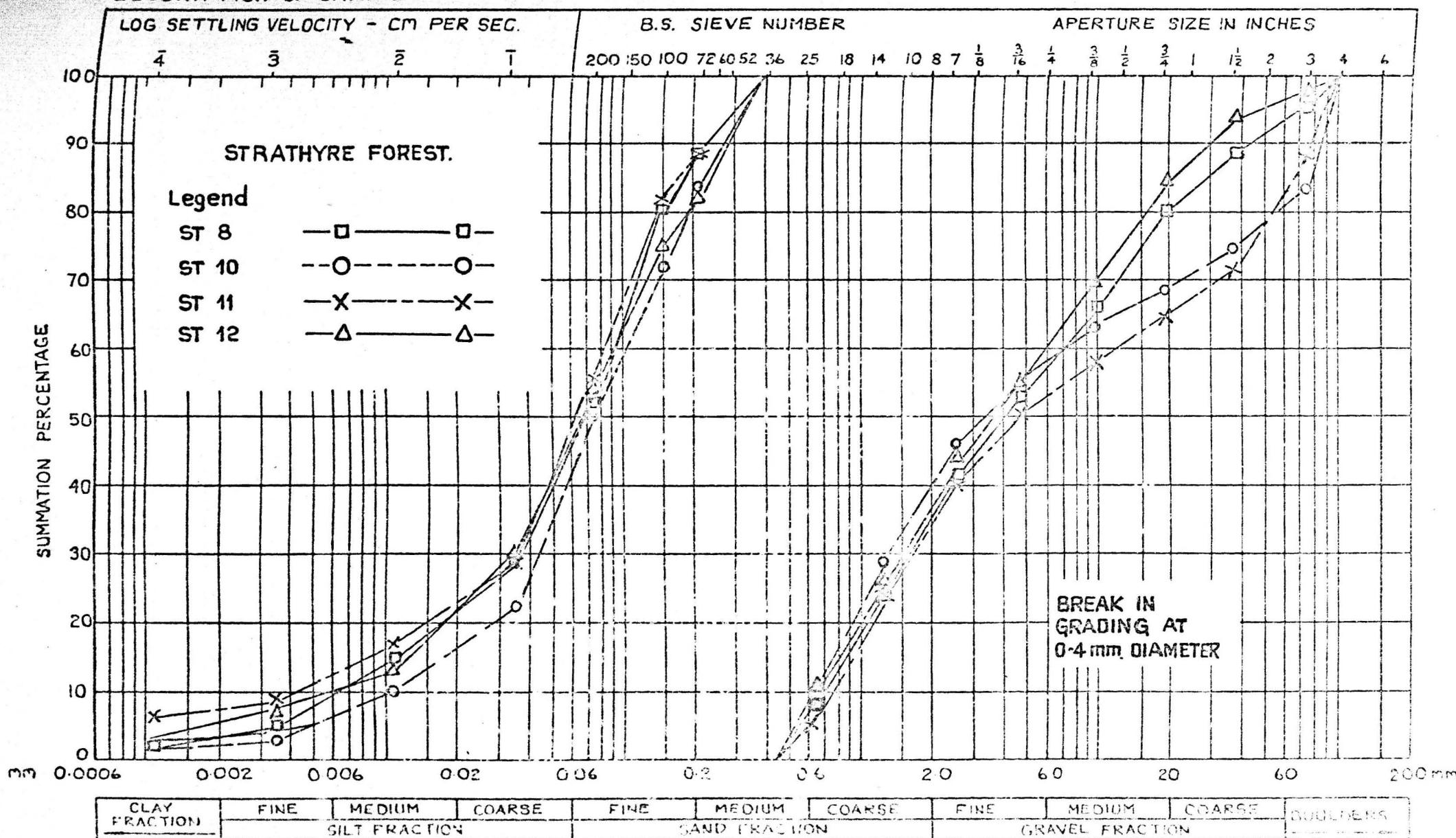
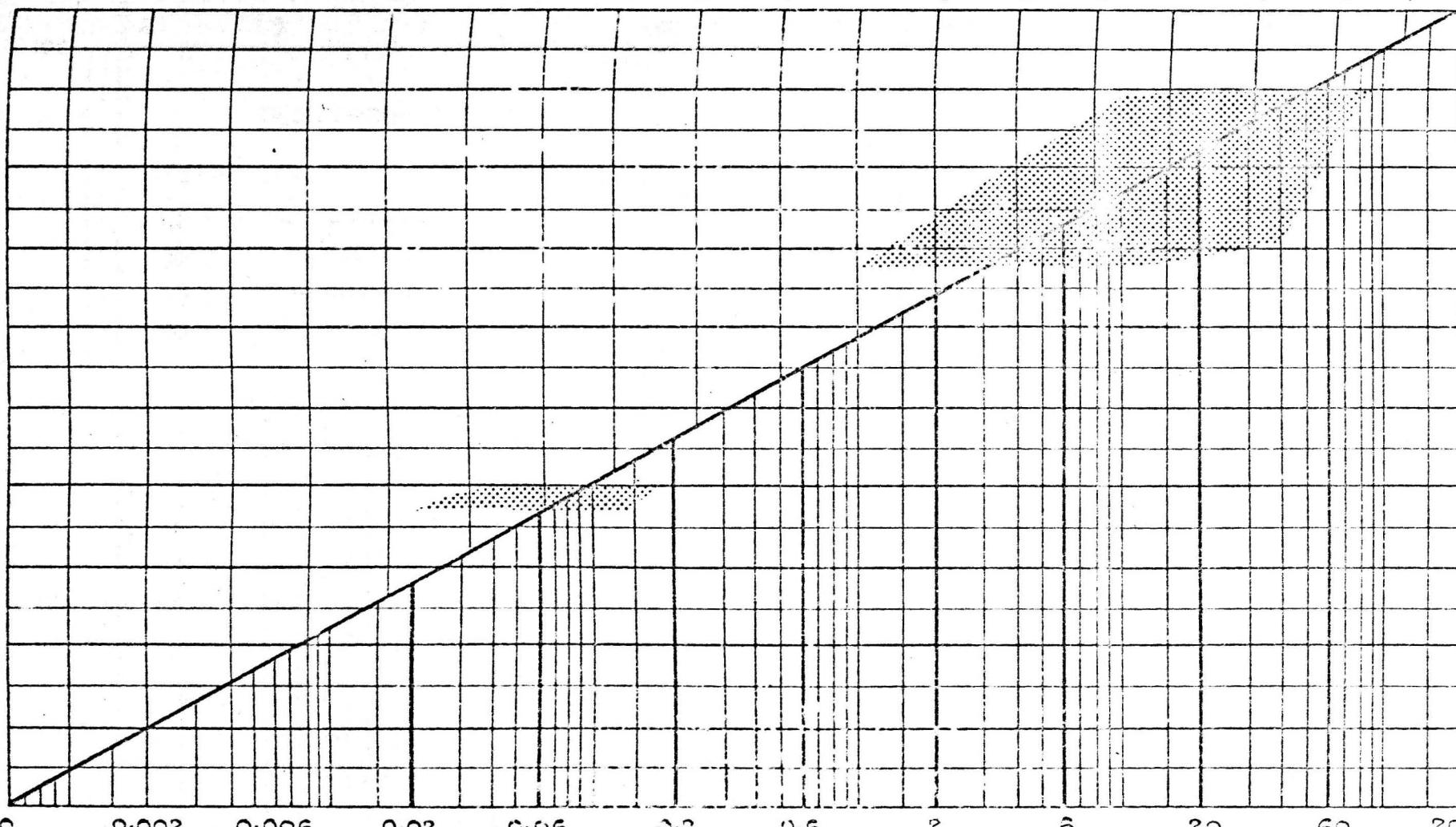


FIG. 5-49. SIZE FRACTIONS FOR STRANZEE TILLS ST 8 - ST 12.

CLAY FRACTION	SILT				SAND				GRAVEL				MODIFIED COBBLES WENTWORTH SCALE
	VERY FINE	FINE	MEDIUM	COARSE	VERY FINE	FINE	MEDIUM	COARSE	VERY COARSE	VERY FINE	FINE	MEDIUM	COARSE

DESCRIPTION OF SAMPLE

10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4 -5 -6 -7 PHI SCALE



CLAY FRACTION	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	STONE	BS. 1377
	SILT FRACTION	SAND FRACTION	GRAVEL FRACTION								

FIG.550. TEXTURAL CLASSIFICATION BASED ON  $Q_1$ ,  $M_d$ ,  $Q_3$  FOR STRATHYRE TILLS

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

DATE OF TEST :-

DESCRIPTION OF SAMPLE :-

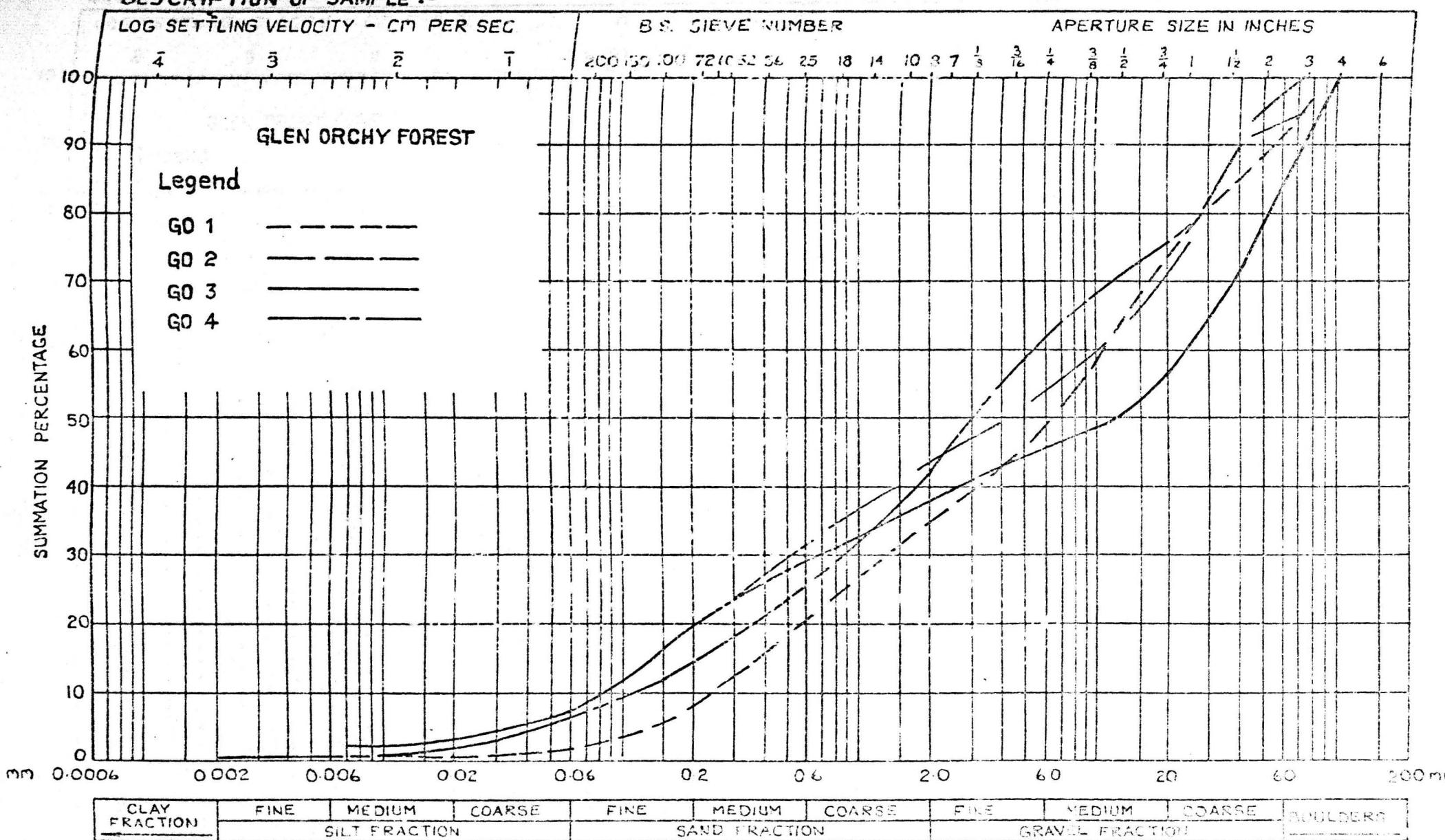


FIG. 5.51 GRADING FOR GLEN ORCHY TILLS G01 - G04.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

DATE OF TEST :-

DESCRIPTION OF SAMPLE :-

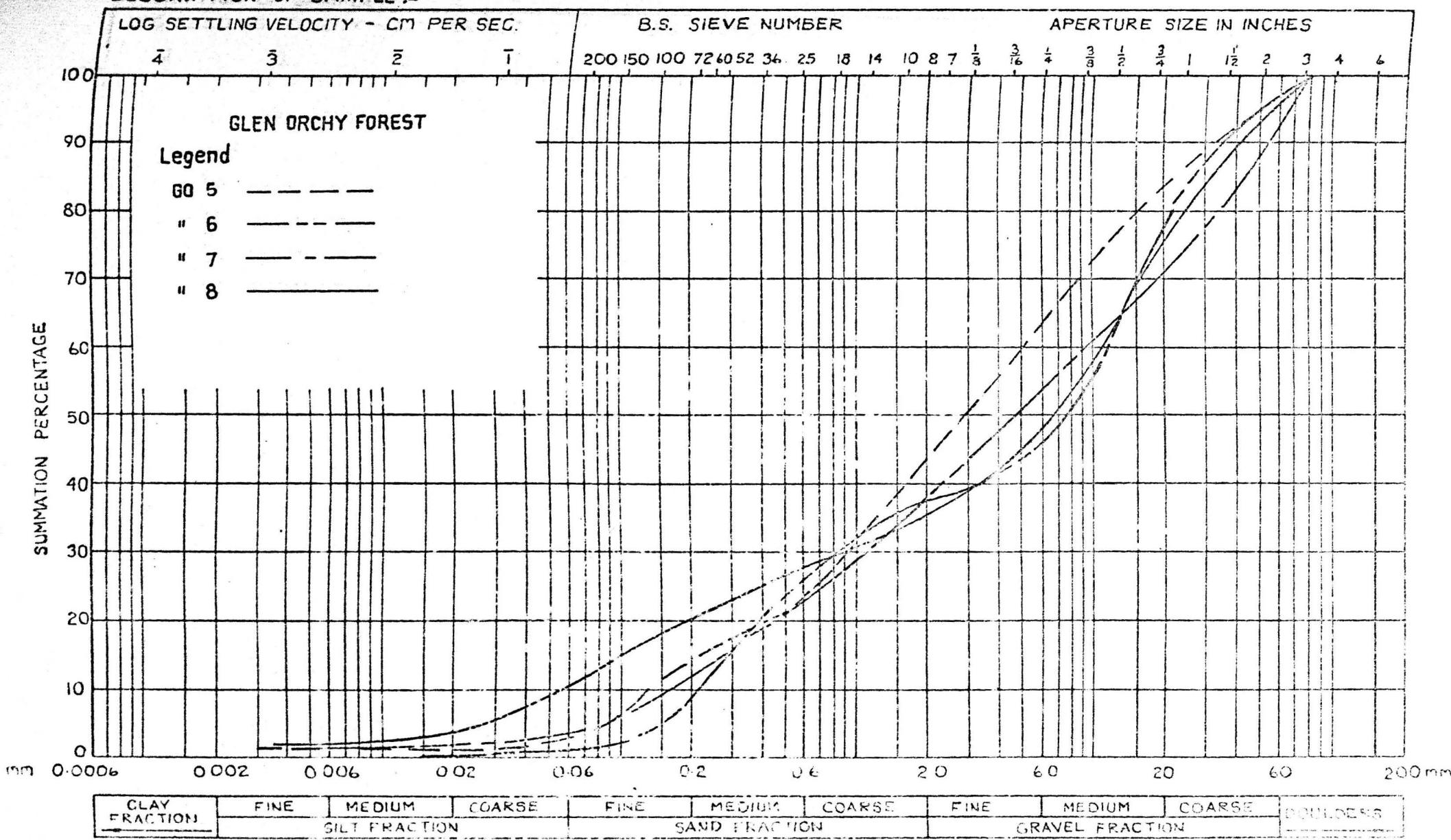


FIG 5.52 GRADINGS FOR GLEN ORCHY TILLS G05 - G08

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

DATE OF TEST :-

DESCRIPTION OF SAMPLE :-

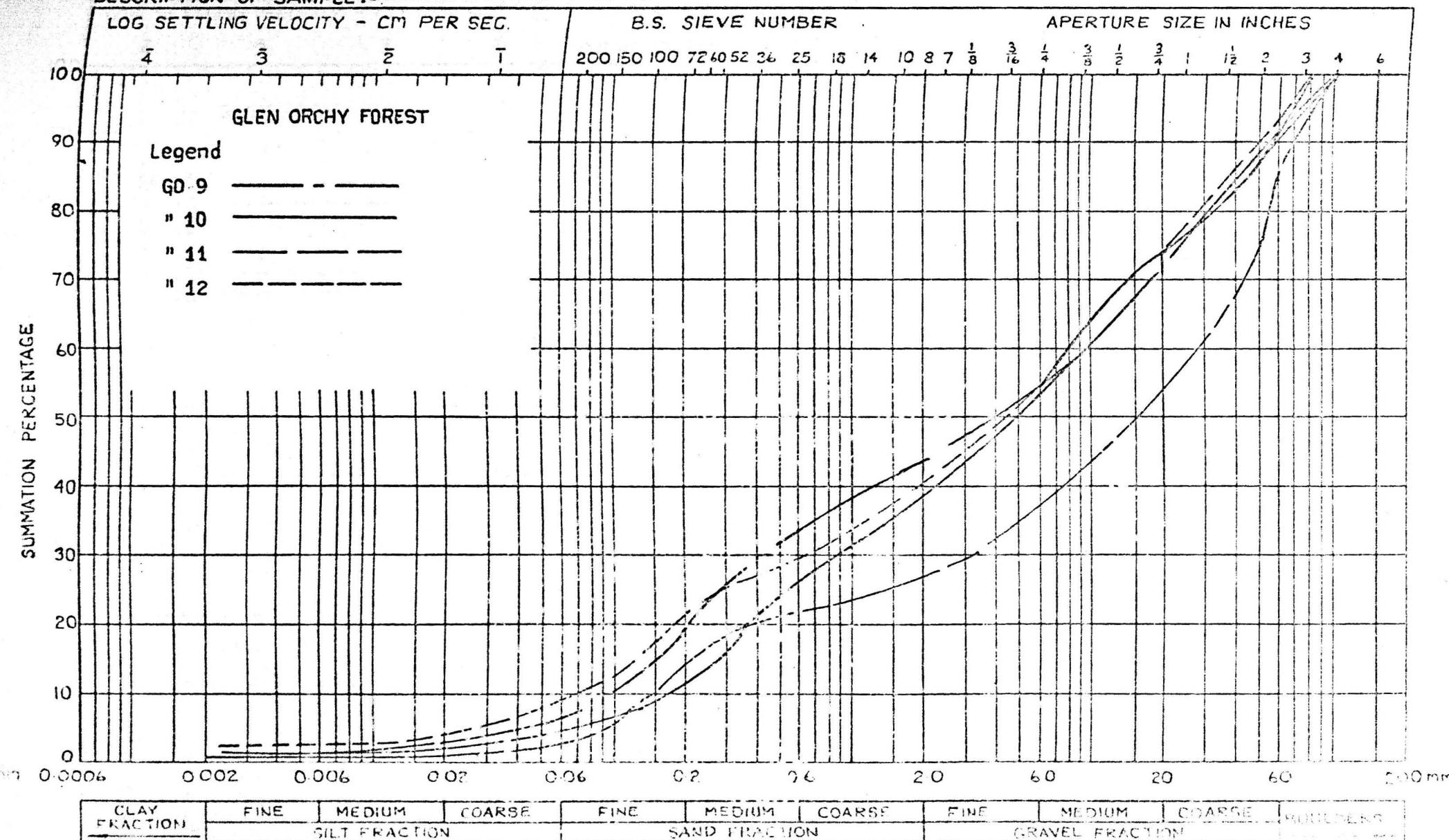


FIG. 5·53 GRADINGS FOR GLEN ORCHY TILLS G09 - G12.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

DATE OF TEST :-

DESCRIPTION OF SAMPLE:-

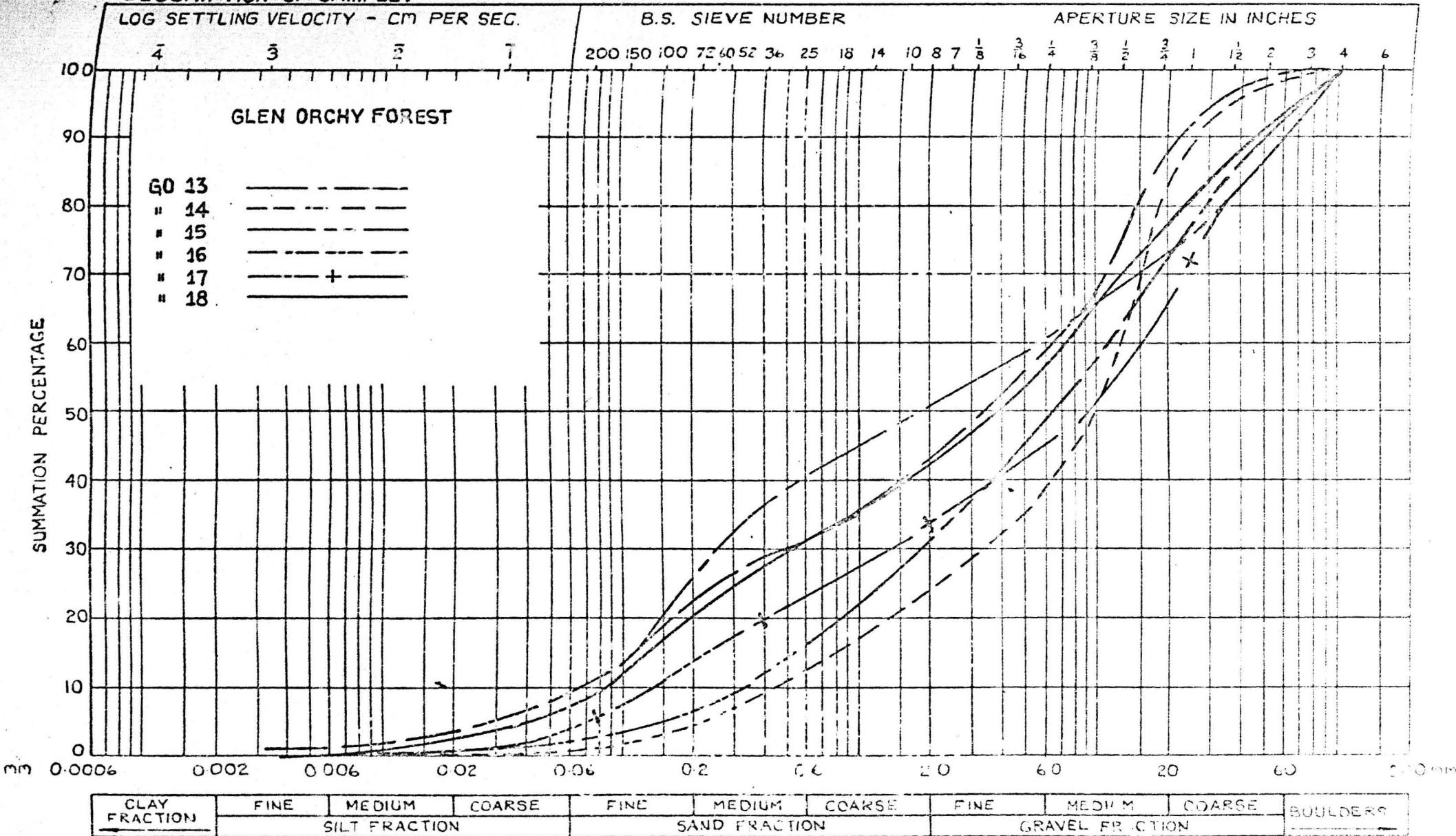


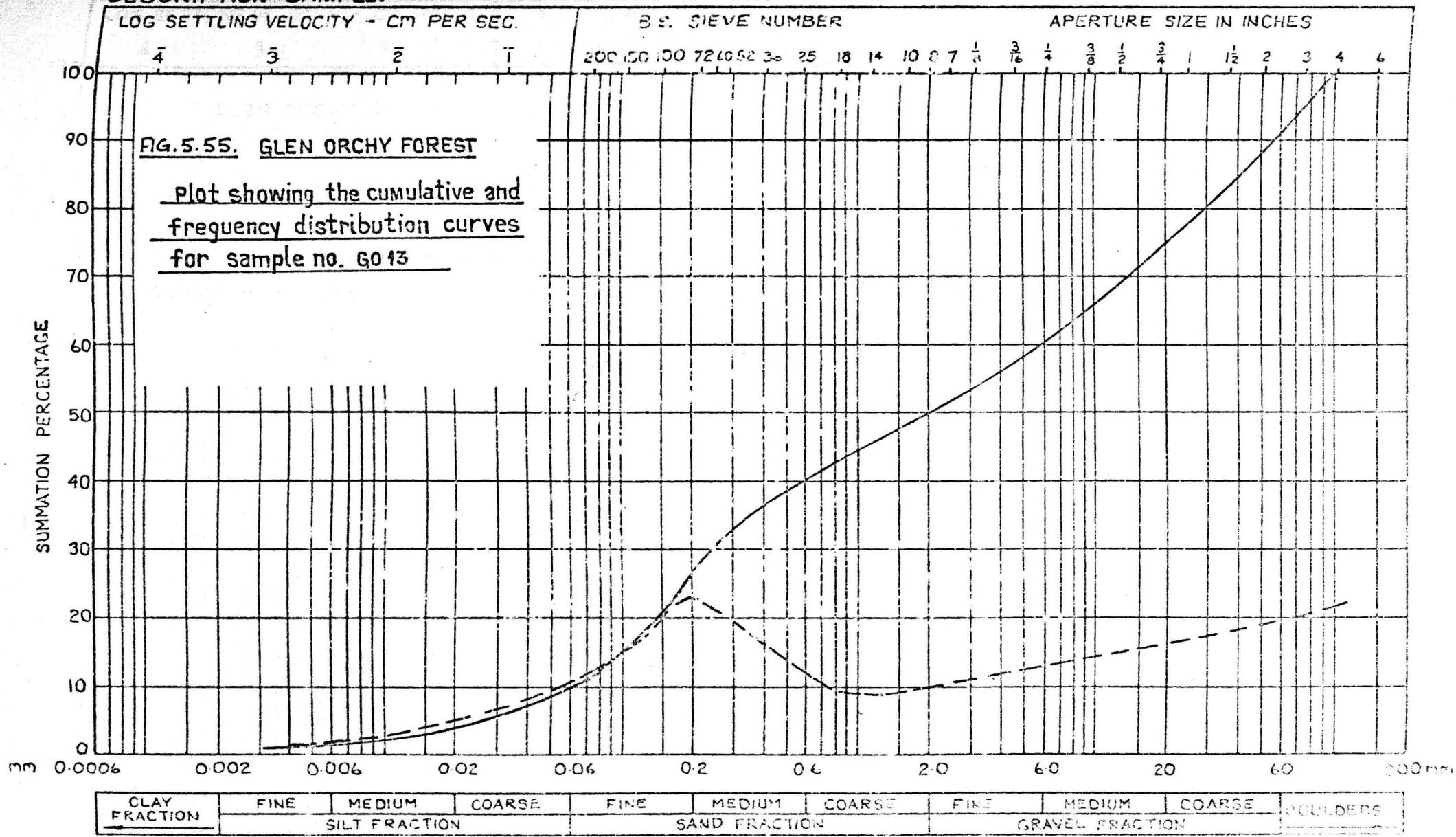
FIG. 5-54

GRADINGS FOR GLEN ORCHY TILLS GO 12 - GO 18.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

**DATE OF TEST:-**

**DESCRIPTION SAMPLE:-**



PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

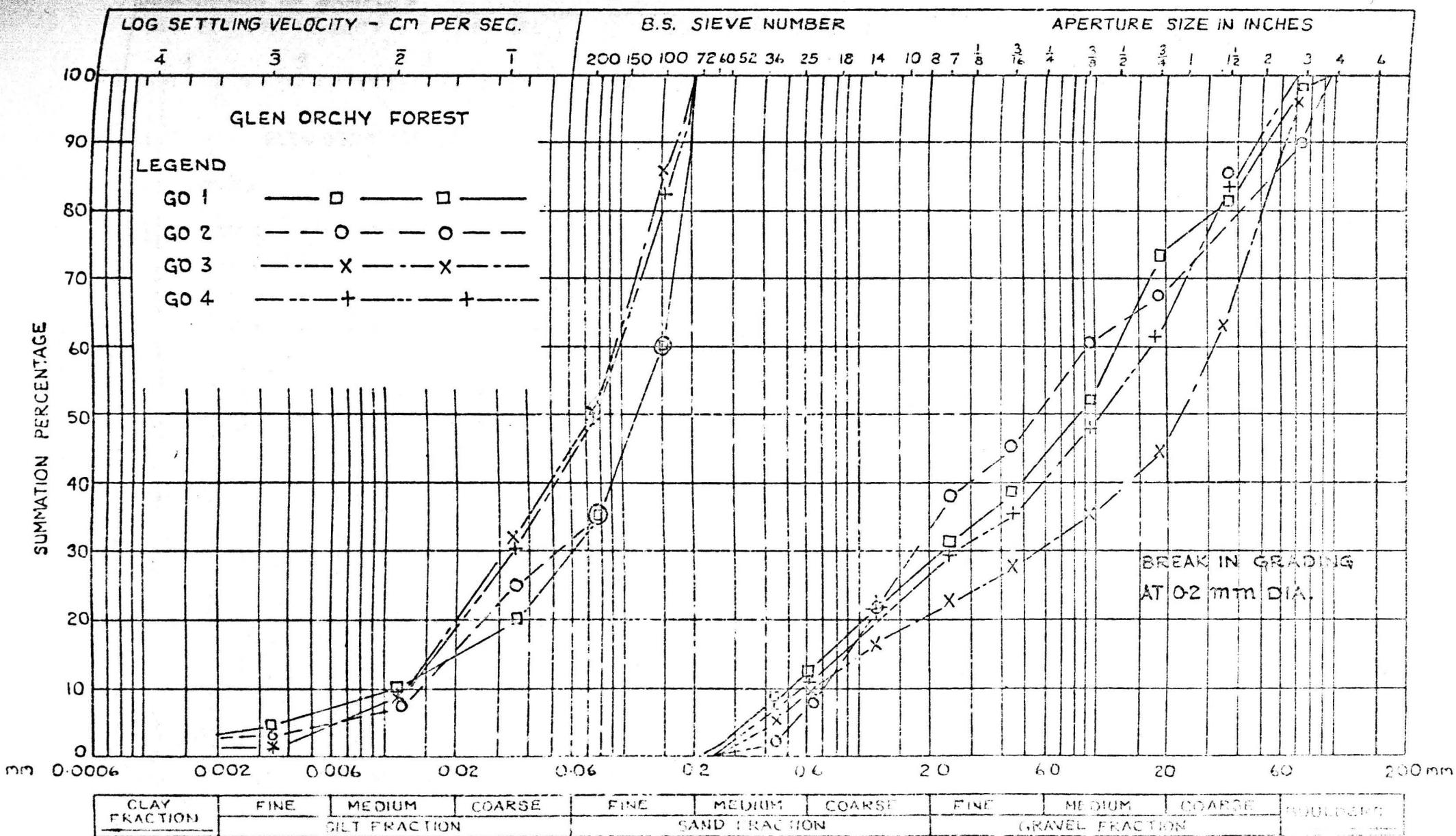


FIG. 5.56. SIZE FRACTIONS FOR GLEN ORCHY TILLS GO1-4.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

**DATE OF TEST :-**

**DESCRIPTION OF SAMPLE :-**

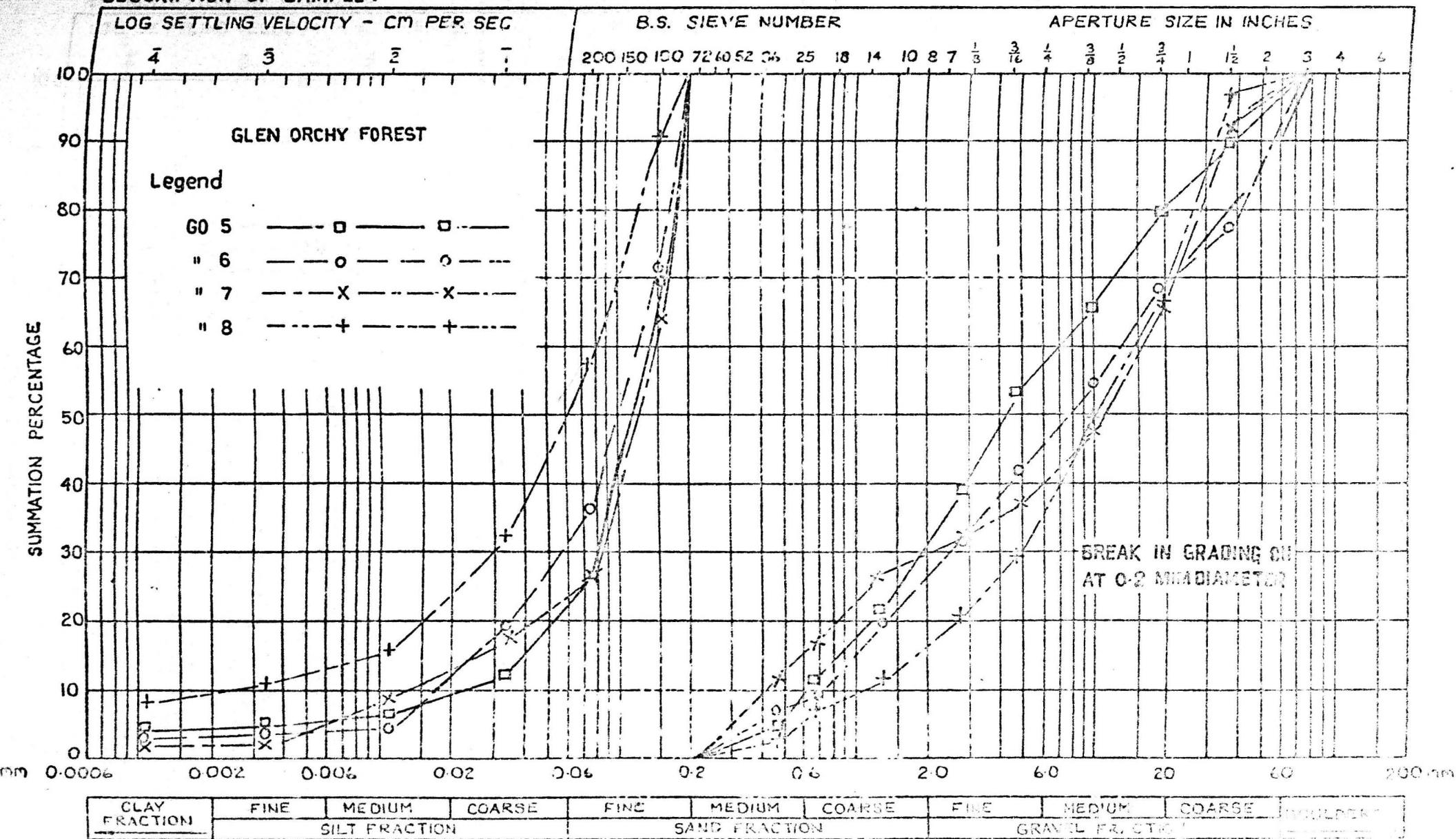


FIG 5.57 SIZE FRACTIONS FOR GLEN EAGHY TILLS G65 - G68

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

DATE OF TEST:-

DESCRIPTION OF SAMPLE:-

LOG SETTLING VELOCITY - CM PER SEC.

B.G. SIEVE NUMBER

APERTURE SIZE IN INCHES

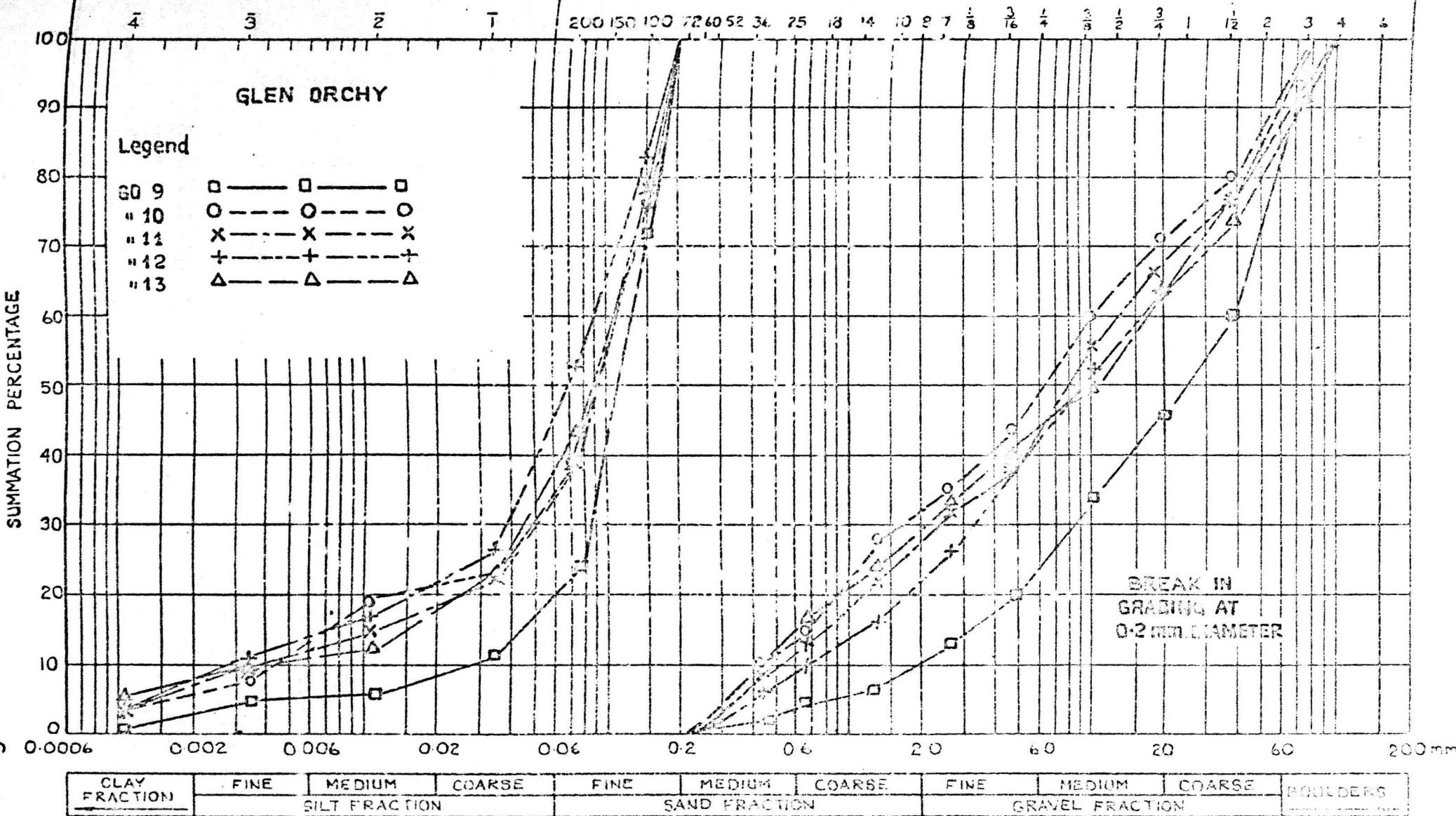


FIG 5.58

SIZE FRACTIONS FOR GLEN ORCHY TILLS GOS - GOSB.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

**DATE OF TEST:-**

**DESCRIPTION OF SAMPLE :-**

**LOG SETTLING VELOCITY - CM PER SEC.**

S.S. SIEVE NUMBER

DATE OF TEST:-

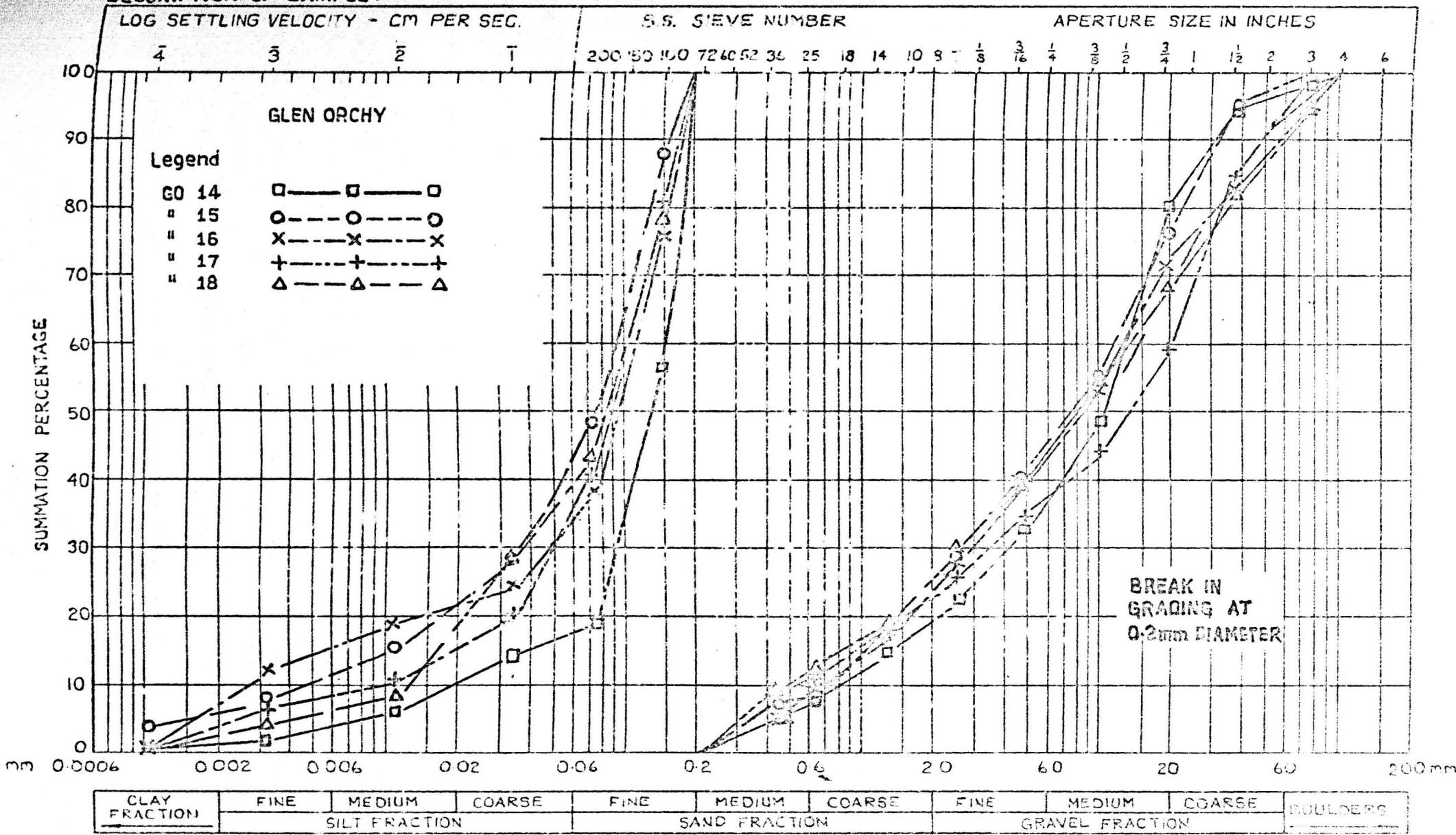
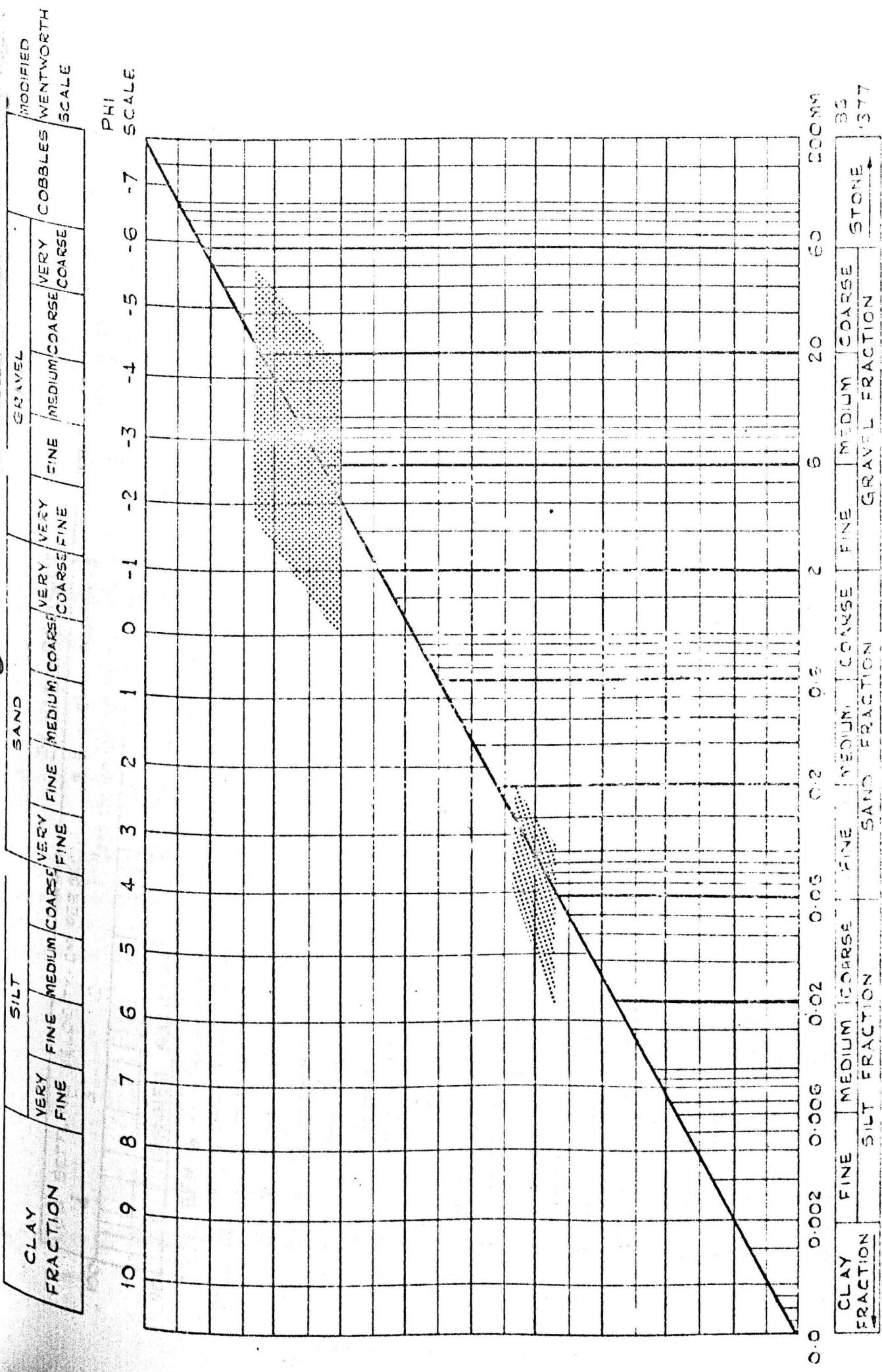


FIG 5-59 SIZE FRACTIONS FOR GLEN ORCHY TILLS G014-G018.



*Fig. 5.60.* TEXTURAL CLASSIFICATION BASED ON QUARTZ, MUD, ORGANIC TILLS.

PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT

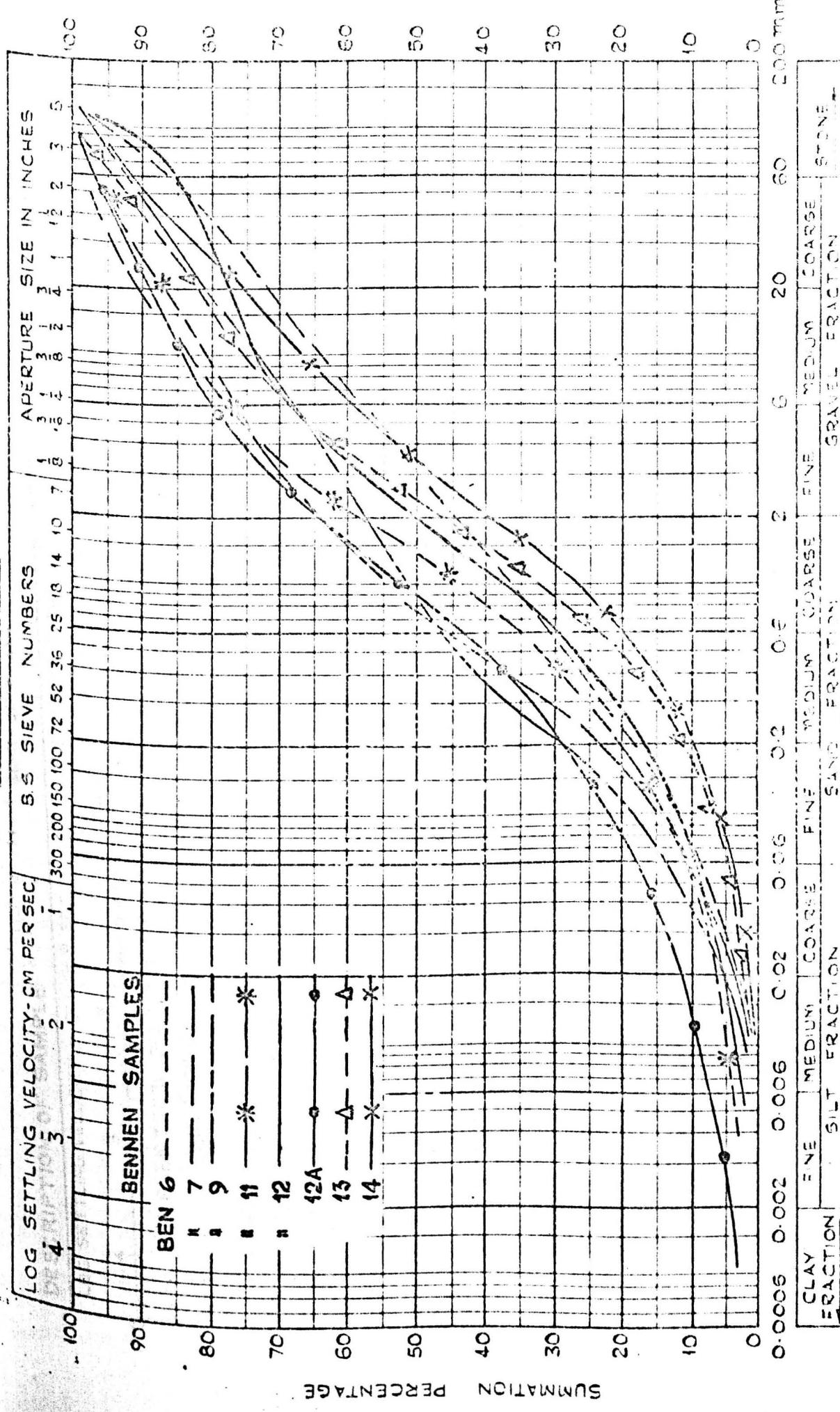


FIG. 5.61 GRAPHS FOR BENNEN TILLS.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

DATE OF TEST

DESCRIPTION OF SAMPLE

LOG SETTLING VELOCITY - CM PER SEC.

B.S. SIEVE NUMBER

APERTURE SIZE IN INCHES

4  
3  
2  
1

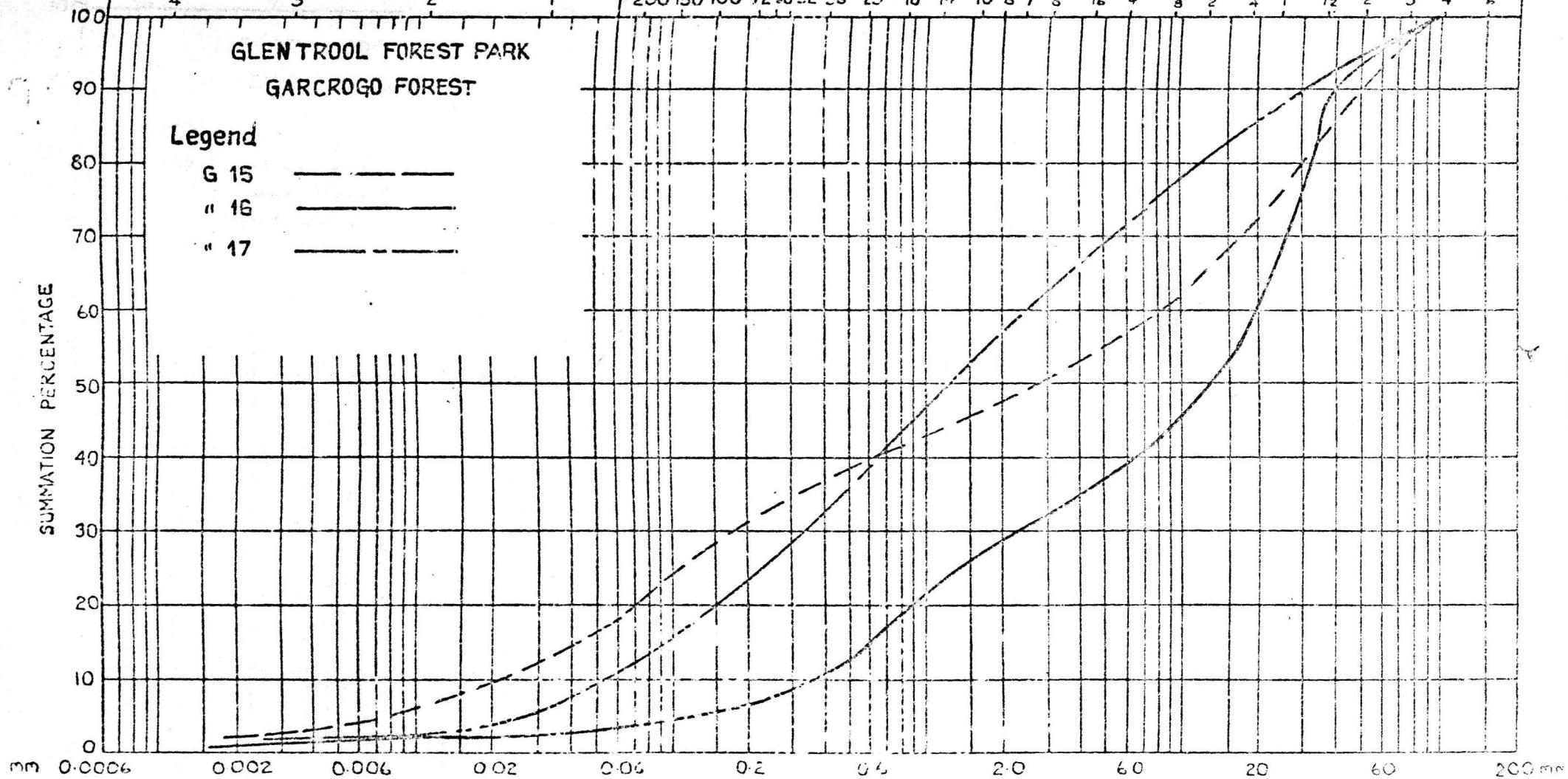
200 150 100 72 40 52 35 25 18 14 10 8 7  $\frac{1}{8}$   $\frac{3}{16}$   $\frac{1}{4}$   $\frac{3}{32}$   $\frac{1}{2}$   $\frac{3}{4}$  1  $\frac{1}{16}$  2 3 4 6

GLEN TROOL FOREST PARK  
GARCROGO FOREST

Legend

- G 15 -----
- " 16 -----
- " 17 -----

SUMMATION PERCENTAGE



CLAY FRACTION	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			

FIG. 5-62 GRADINGS FOR GARCROGO TILLS

PARTICLE SIZE DISTRIBUTION  
SEMI - LOG PLOT

DATE OF TEST :-

DESCRIPTION OF SAMPLE :-

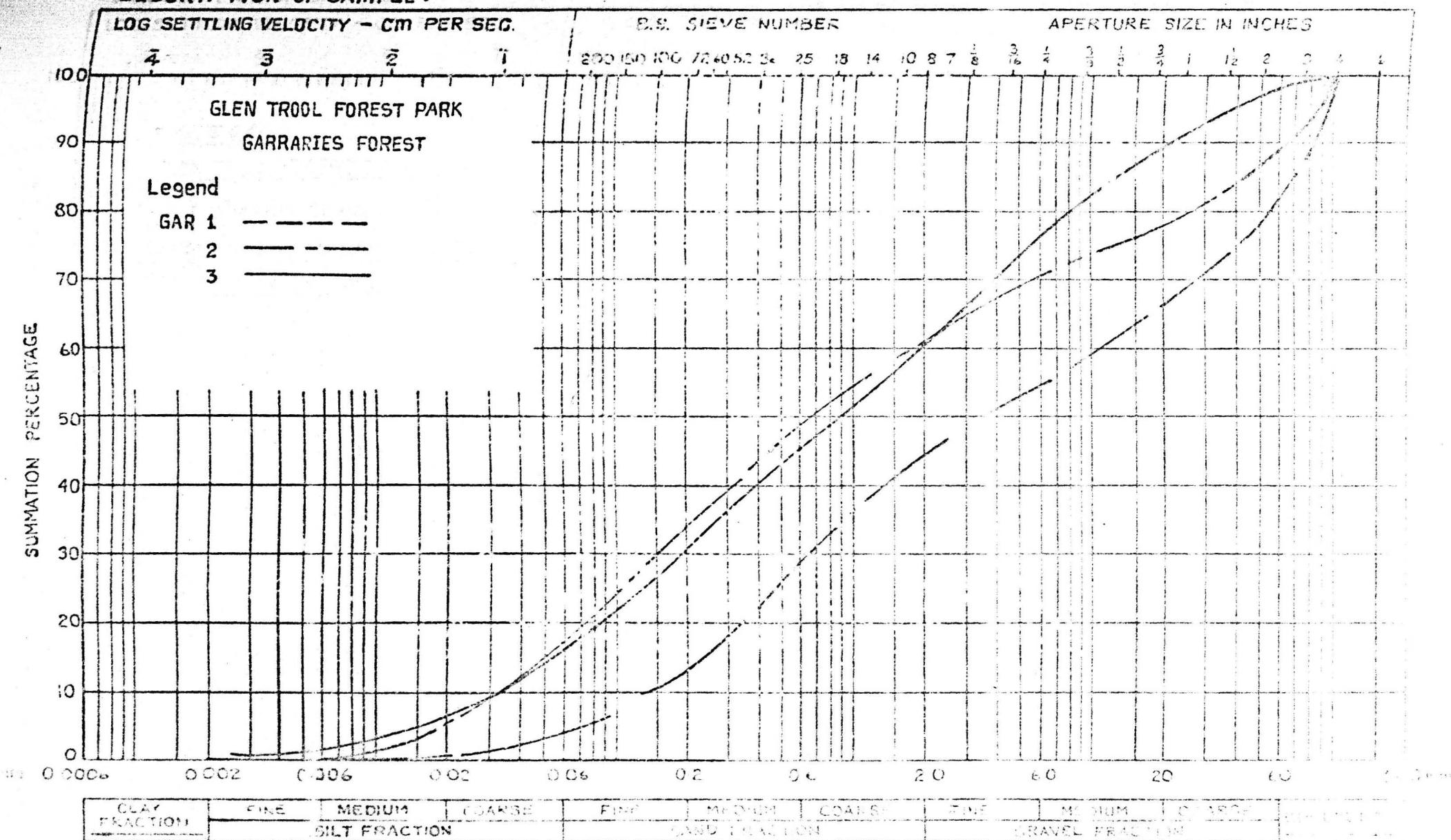


FIG. 5-63

GRADING FOR GARRARIES FOREST

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

DATE OF TEST :-

DESCRIPTION OF SAMPLE :-

LOG SETTLING VELOCITY - CM PER SEC.

B.S. SIEVE NUMBER

APERTURE SIZE IN INCHES

4  
3  
2  
1

200 150 100 72 60 52 36 25 18 14 10 8 7 1/8 1/16 1/32 1/48 1/96 1/192 1/384 1/768 1/1536 1/3072 1/6144 1/12288 1/24576 1/49152 1/98304 1/196608 1/393216 1/786432 1/1572864 1/3145728 1/6291456 1/12582912 1/25165824 1/50331648 1/100663296 1/201326592 1/402653184 1/805306368 1/1610612736 1/3221225472 1/6442450944 1/12884901888 1/25769803776 1/51539607552 1/10307921512 1/20615843024 1/41231686048 1/82463372096 1/164926744192 1/329853488384 1/659706976768 1/1319413953536 1/2638827907072 1/5277655814144 1/10555311628288 1/21110623256576 1/422212465131536 1/844424930263072 1/1688849860526144 1/3377699721052288 1/6755399442104576 1/13510798884209152 1/27021597768418304 1/54043195536836608 1/108086391073673216 1/216172782147346432 1/432345564294692864 1/864691128589385728 1/1729382257178771456 1/3458764514357542912 1/6917529028715085824 1/13835058057430171648 1/27670116114860343296 1/55340232229720686592 1/110680464459441373184 1/221360928918882746368 1/442721857837765492736 1/885443715675530985472 1/1770887431351061970944 1/3541774862702123941888 1/7083549725404247883776 1/14167099450808495767552 1/28334198901616991535104 1/56668397803233983070208 1/113336795606467966140416 1/226673591212935932280832 1/453347182425871864561664 1/906694364851743729123328 1/1813388729703487458246656 1/3626777459406974916493312 1/7253554918813949832986624 1/14507109837627899665973248 1/29014219675255799331946496 1/58028439350511598663892992 1/11605687870102359732785984 1/23211375740204719465571968 1/46422751480409438931143936 1/92845402960818877862287872 1/185690805921637755724575744 1/371381611843275511449151488 1/742763223686551022898302976 1/1485526447373052045796605952 1/2971052894746104091593211904 1/5942105789492208183186423808 1/11884211578984016366372857616 1/23768423157968032732745715232 1/47536846315936065465491430464 1/95073692631872130930982860928 1/190147385263744261861965721856 1/380294770527488523723931443712 1/760589541054977047447862887424 1/1521179082109954094895725774848 1/3042358164219908189791451549696 1/6084716328439816379582903099392 1/12169432656879632791165860198784 1/24338865313759265582331720397568 1/48677730627518531164663440795136 1/97355461254037062329326881590272 1/194710922508074124658653763180544 1/389421845016148249317307526361088 1/778843690032296498634615052722176 1/1557687380645930997269230105444352 1/3115374761291861994538460210888704 1/6230749522583723989076920421777408 1/1246149854516744978815384084354816 1/2492299709033489957630768168679232 1/4984599418066979915261536337358464 1/9969198836133959830523072674716928 1/19938397672267919661046145349433856 1/39876795344535839322092290688867712 1/79753590689071678644184581377735424 1/15950718137814335728836916275547088 1/31901436275628671457673832551094176 1/63802872551257342915347665102188352 1/127605745102514685830695325204376704 1/255211490205029371661390650408753408 1/510422980410058743322781300817567816 1/1020845960820117486645562601635355632 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PARTICLE SIZE DISTRIBUTION

SEMI - LOG PLOT

DATE OF TEST :-

DESCRIPTION OF SAMPLE :-

LOG SETTLING VELOCITY - CM. PER SEC.

B.S. SIEVE NUMBER

APERTURE SIZE IN INCHES

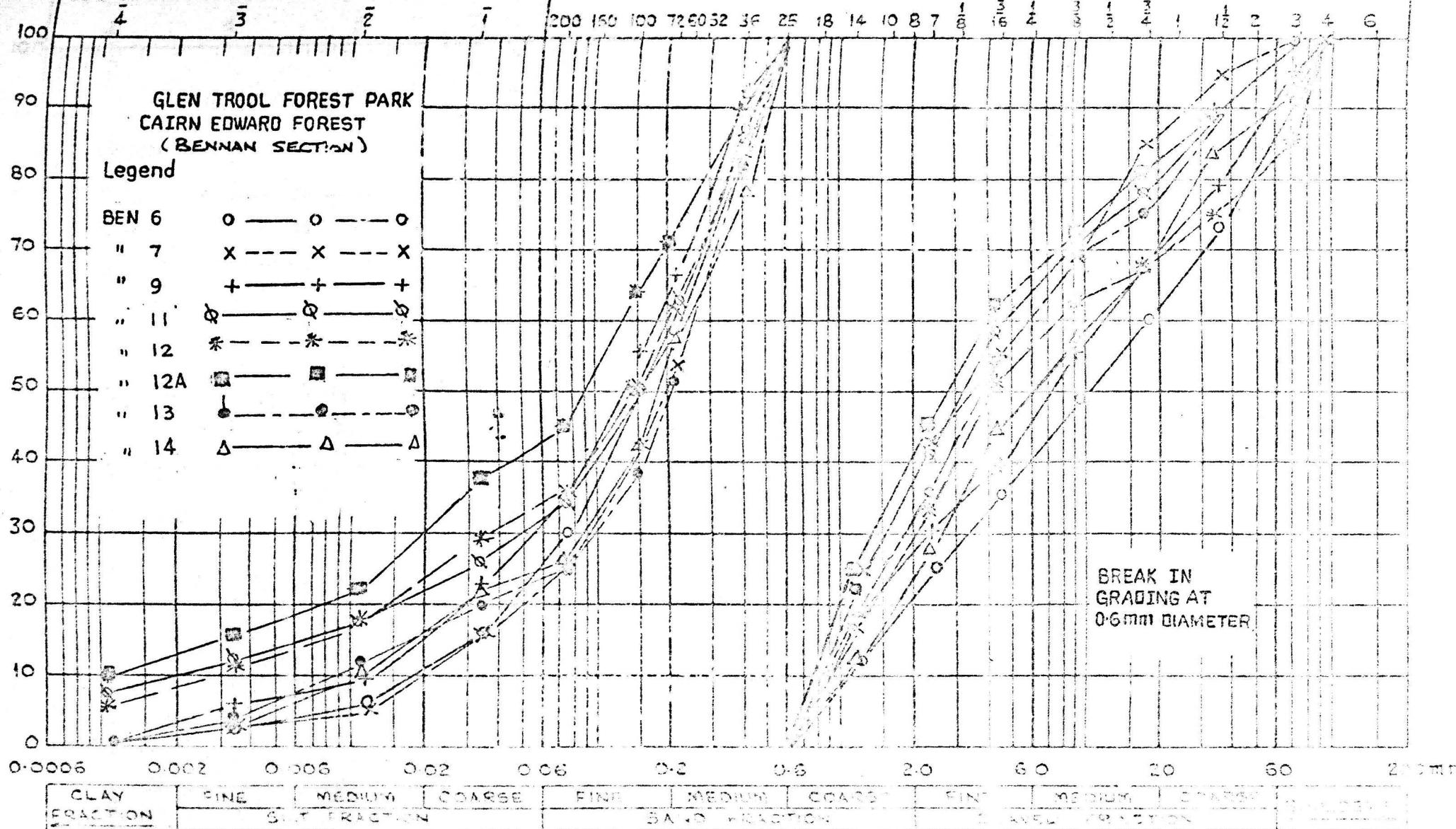


FIG No. 5.65

SIZE FRACTIONS FOR BENNAN TRAILS

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

DATE OF TEST :-

DESCRIPTION OF SAMPLE

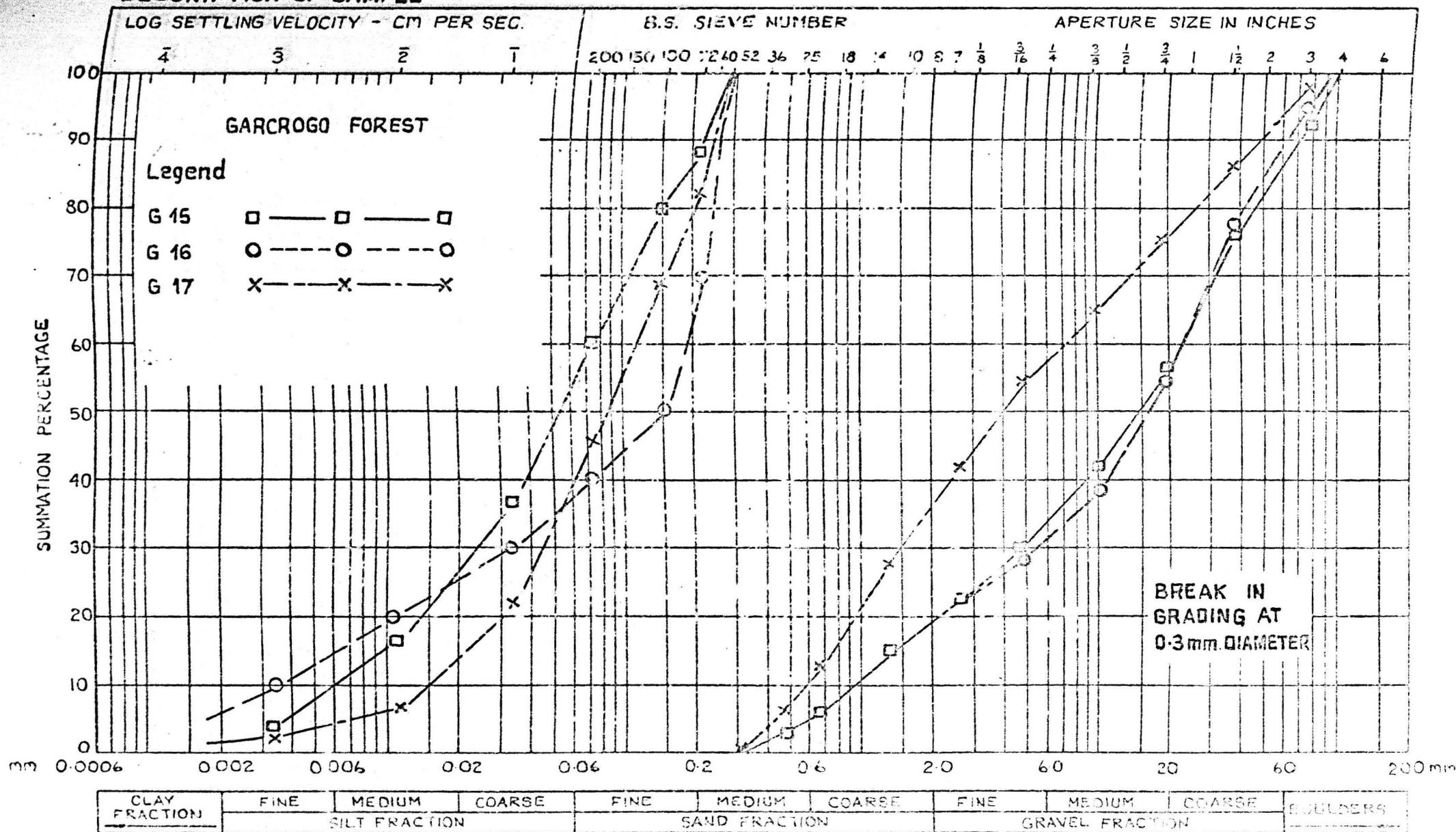


FIG. 5.66. SIZE FRACTIONS FOR GARCROGO TILLS.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

DATE OF TEST:-

DESCRIPTION OF SAMPLE:-

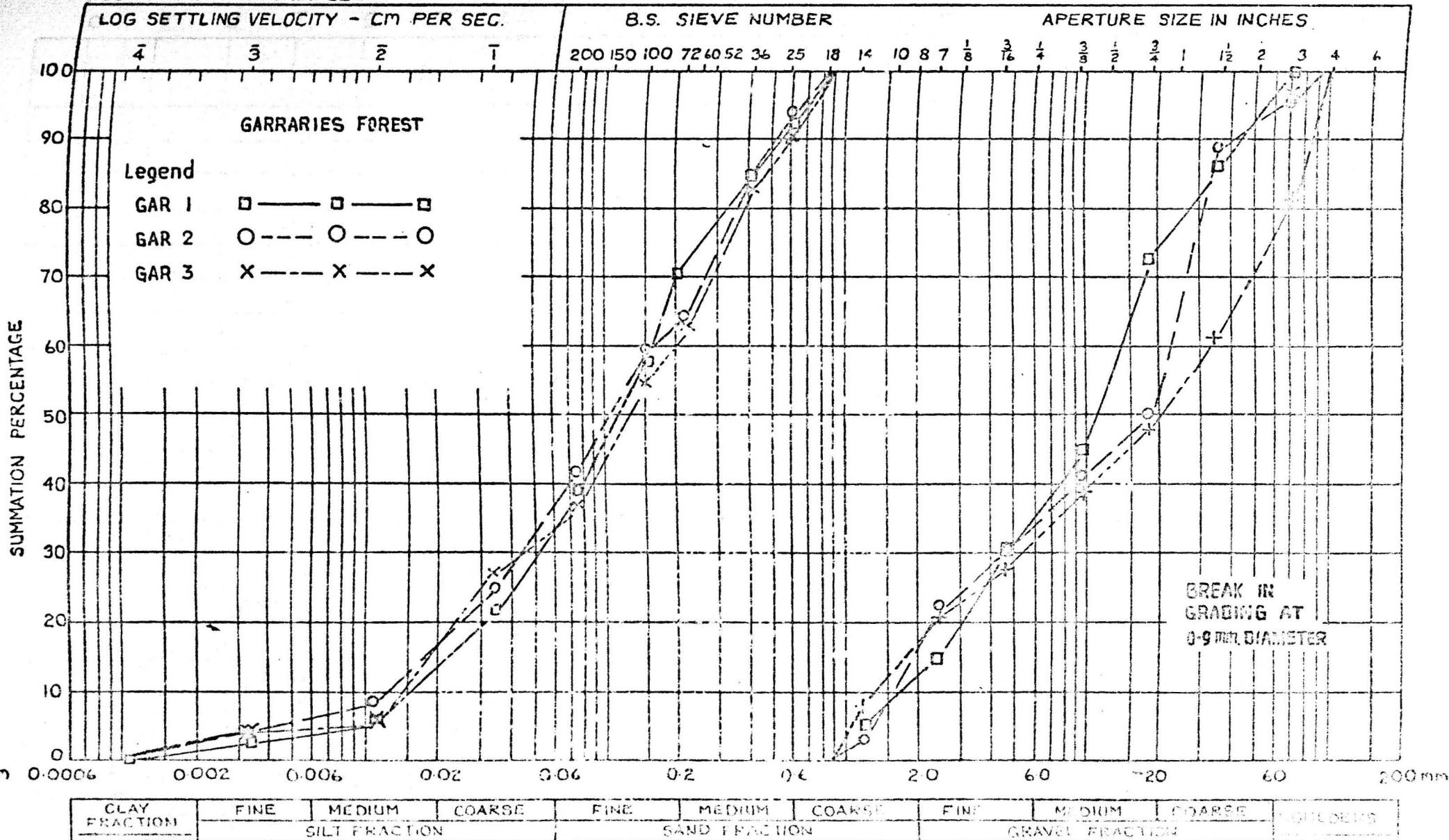


FIG 5.67 SIZE FRACTIONS FOR GARRARIES TILES

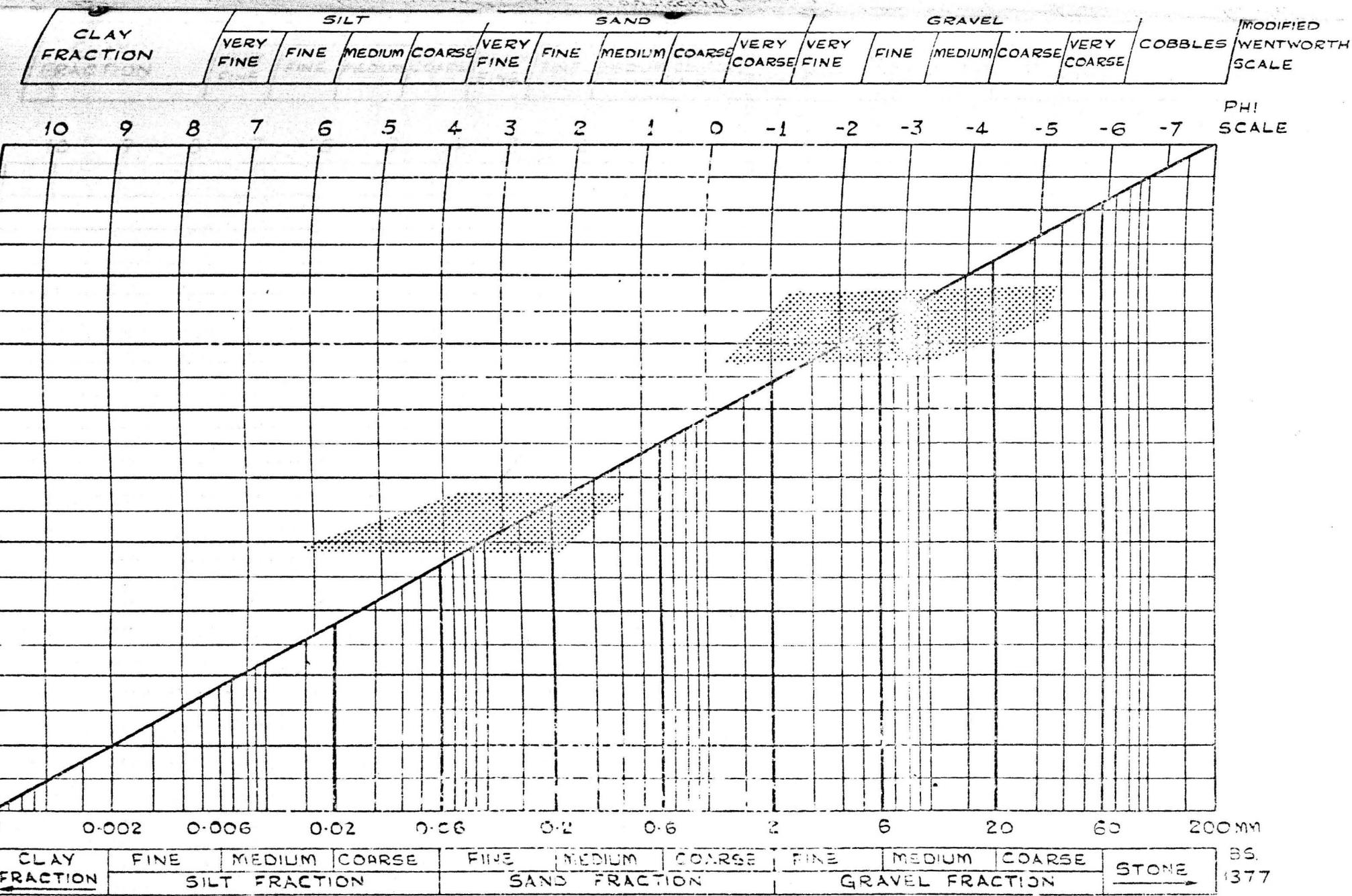


FIG. 5.6B. TEXTURAL CLASSIFICATION BASED ON  $\text{S}_1$ ,  $\text{M}_d$ ,  $\text{C}$  FOR BIRNAN TILLS.

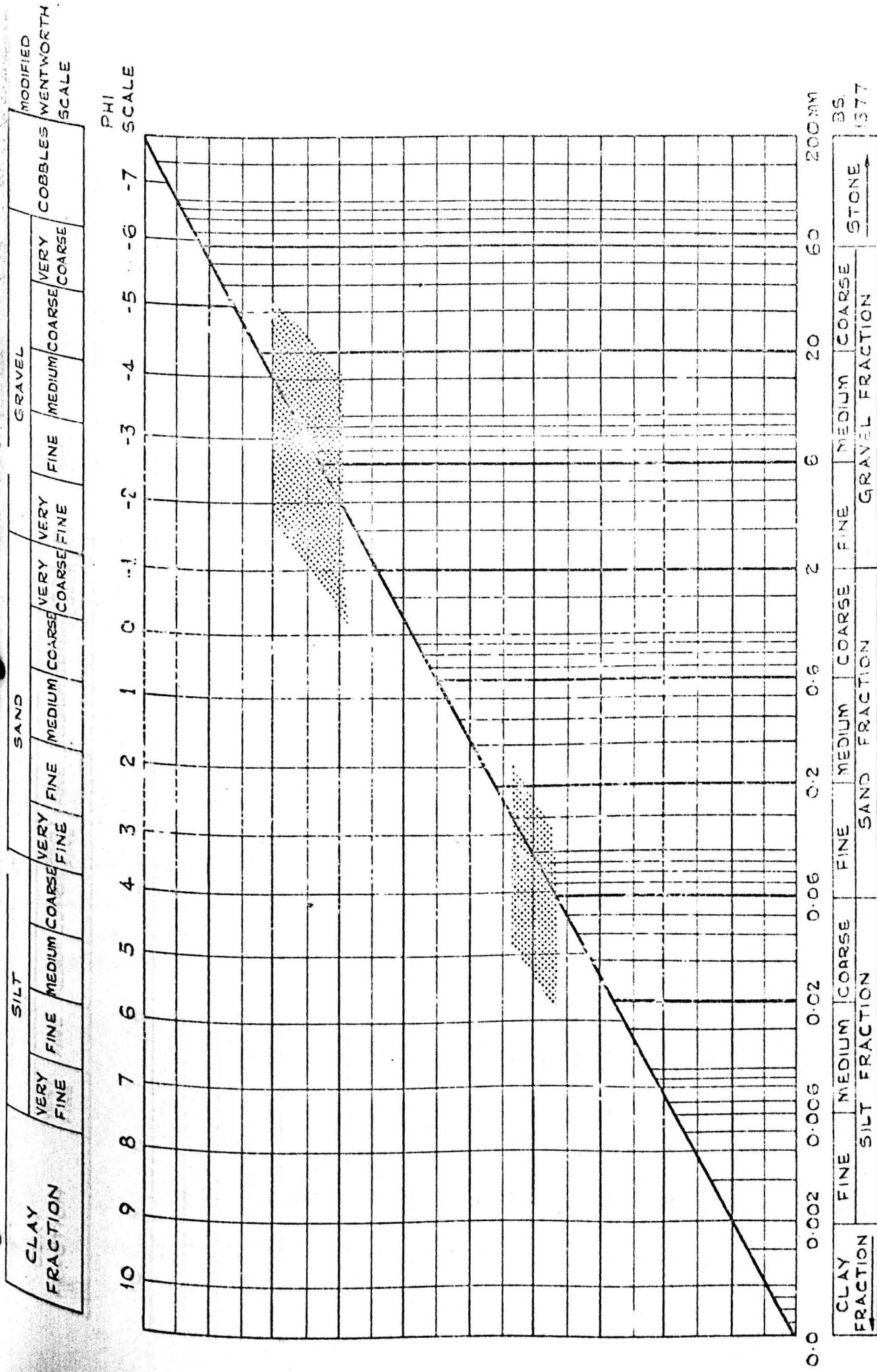
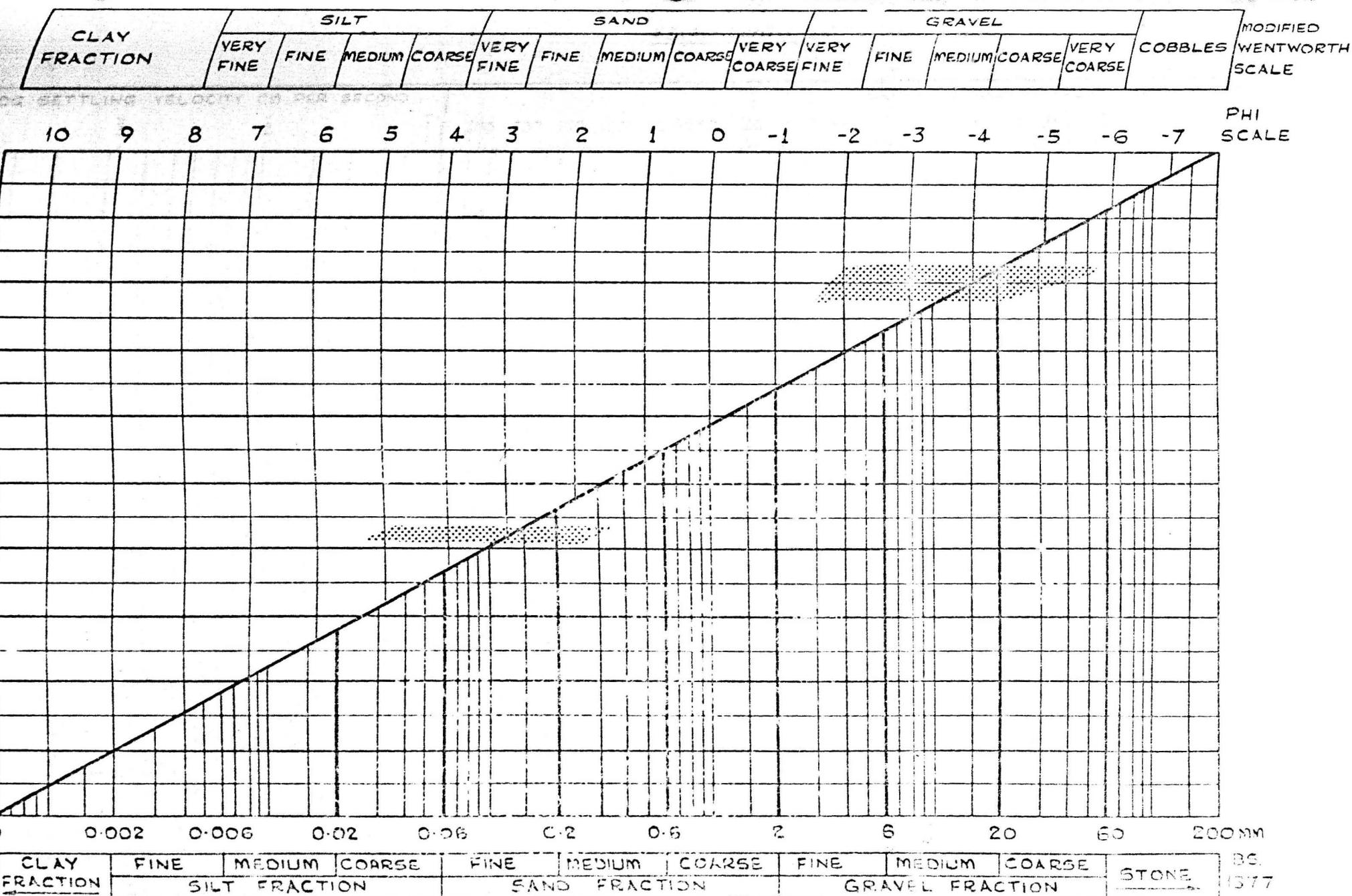


FIG. 5.6.9. TEXTURAL CLASSIFICATION BASED ON  $Q_1$ ,  $M_1$ ,  $S_1$  FOR GROSSO TILLS

FIG. 5.70. TEXTURAL CLASSIFICATION BASED ON  $Q_1$ ,  $M_d$ ,  $Q_3$  FOR GARRARIE'S TILLS.

PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT.

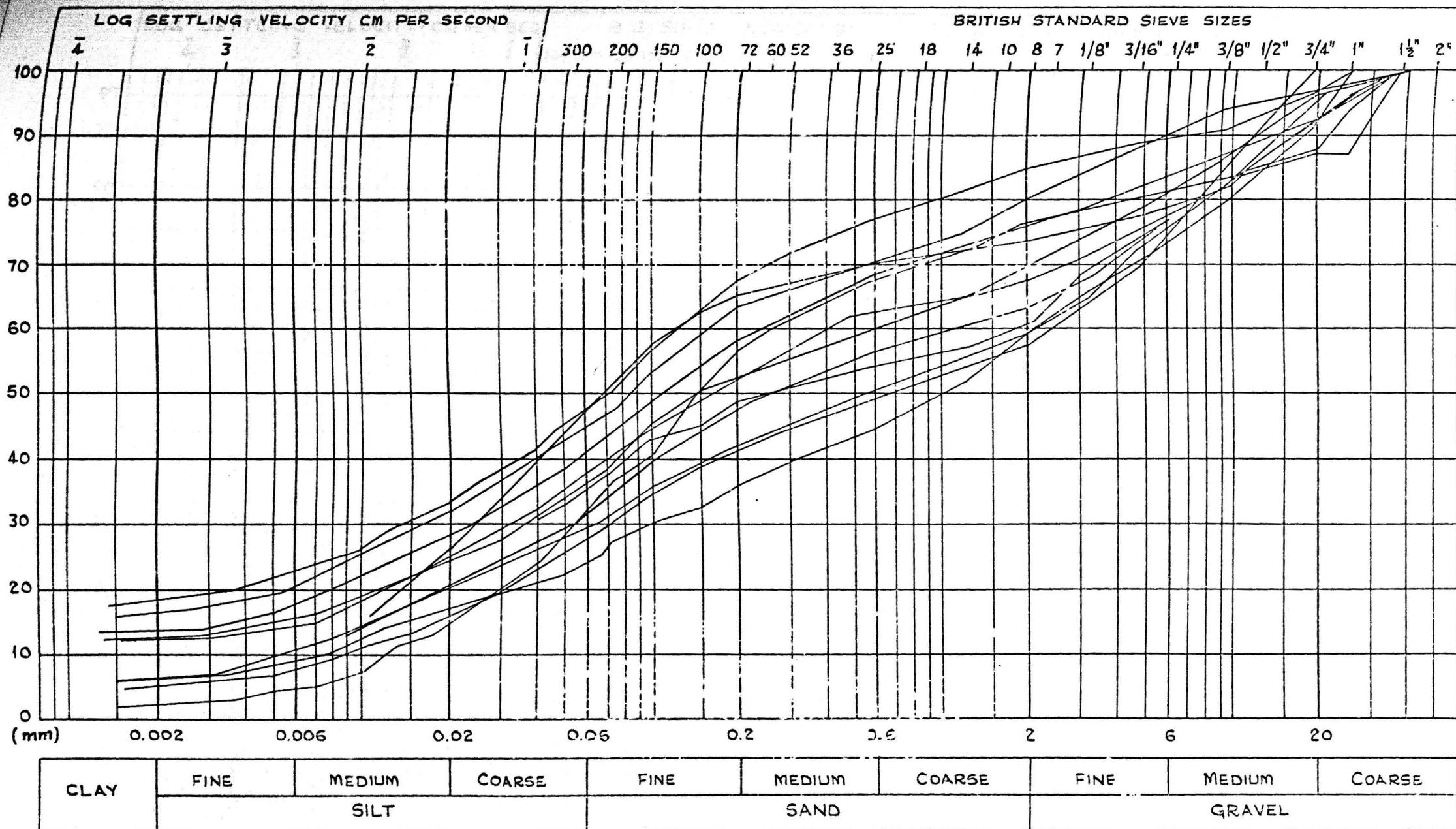


FIG. 5.71. GRADINGS FOR BACKWATER DAY UPPER SILTY TILL.

PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT

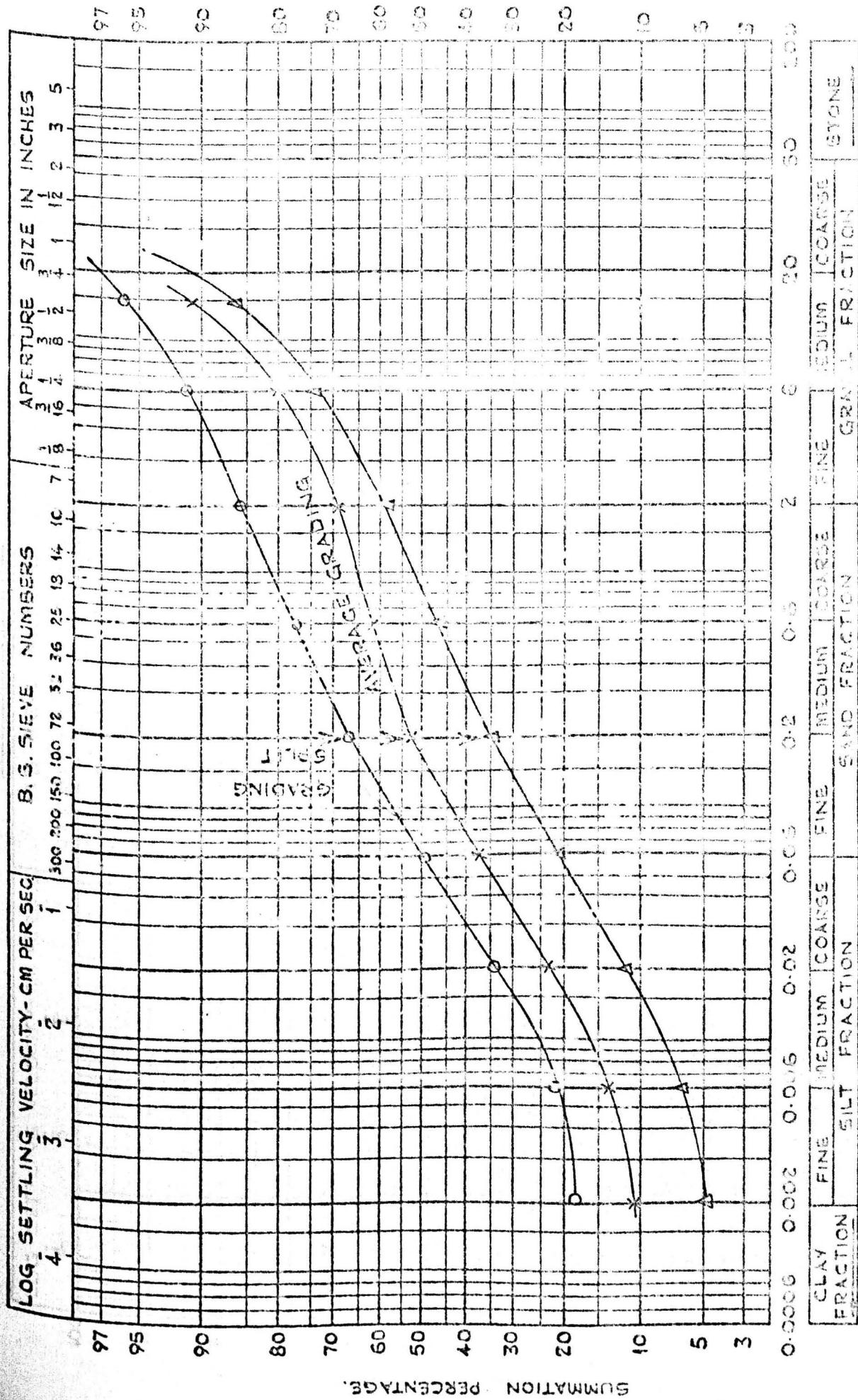


FIG. 5.72 LOG PROBABILITY PLOT OF BLACK JASPER BEACH, CITY OF L.

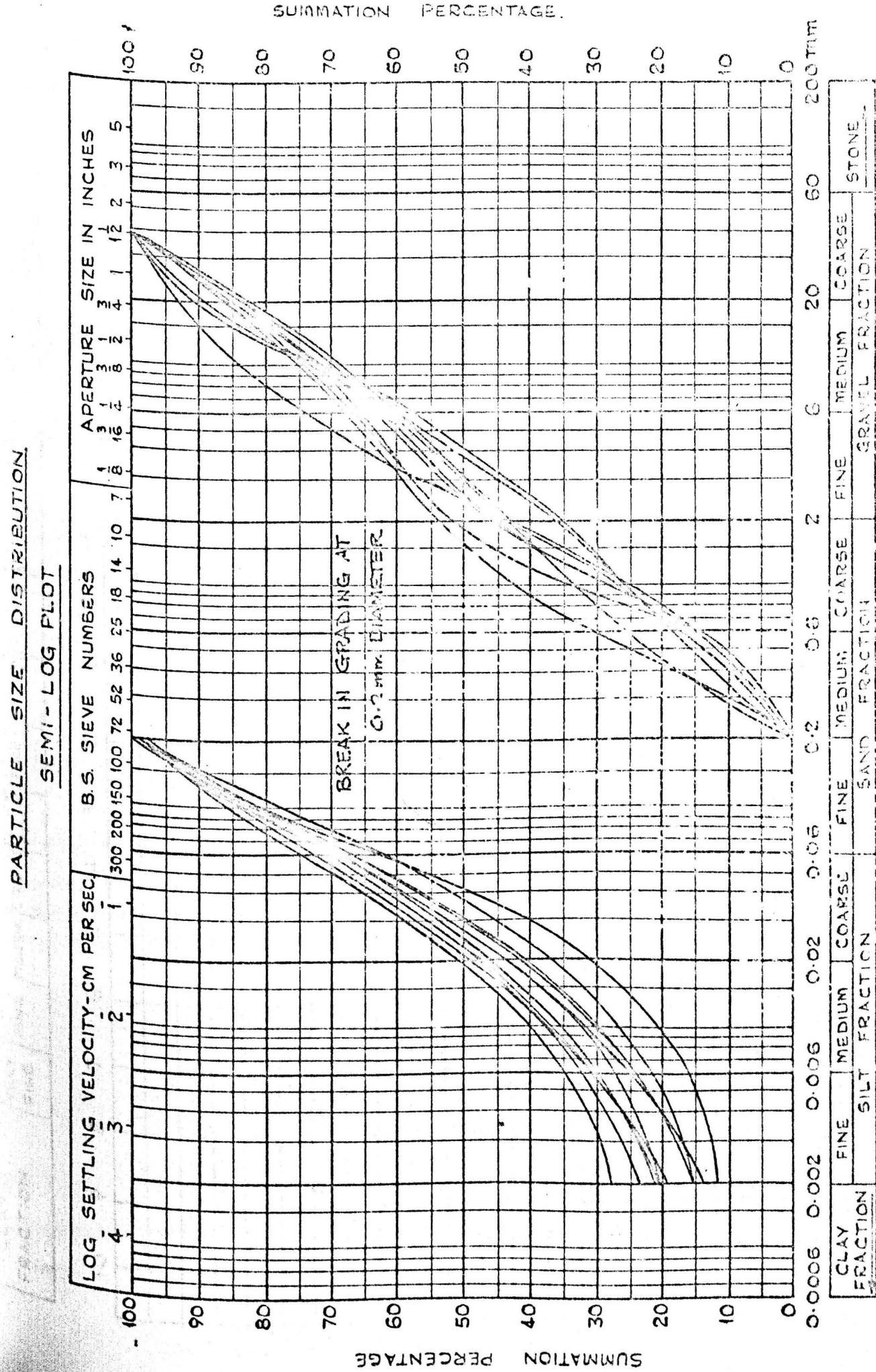


FIG 5.73 SIZE FRACTIONATION FOR BACKWATER DOPPER SILTY TILL

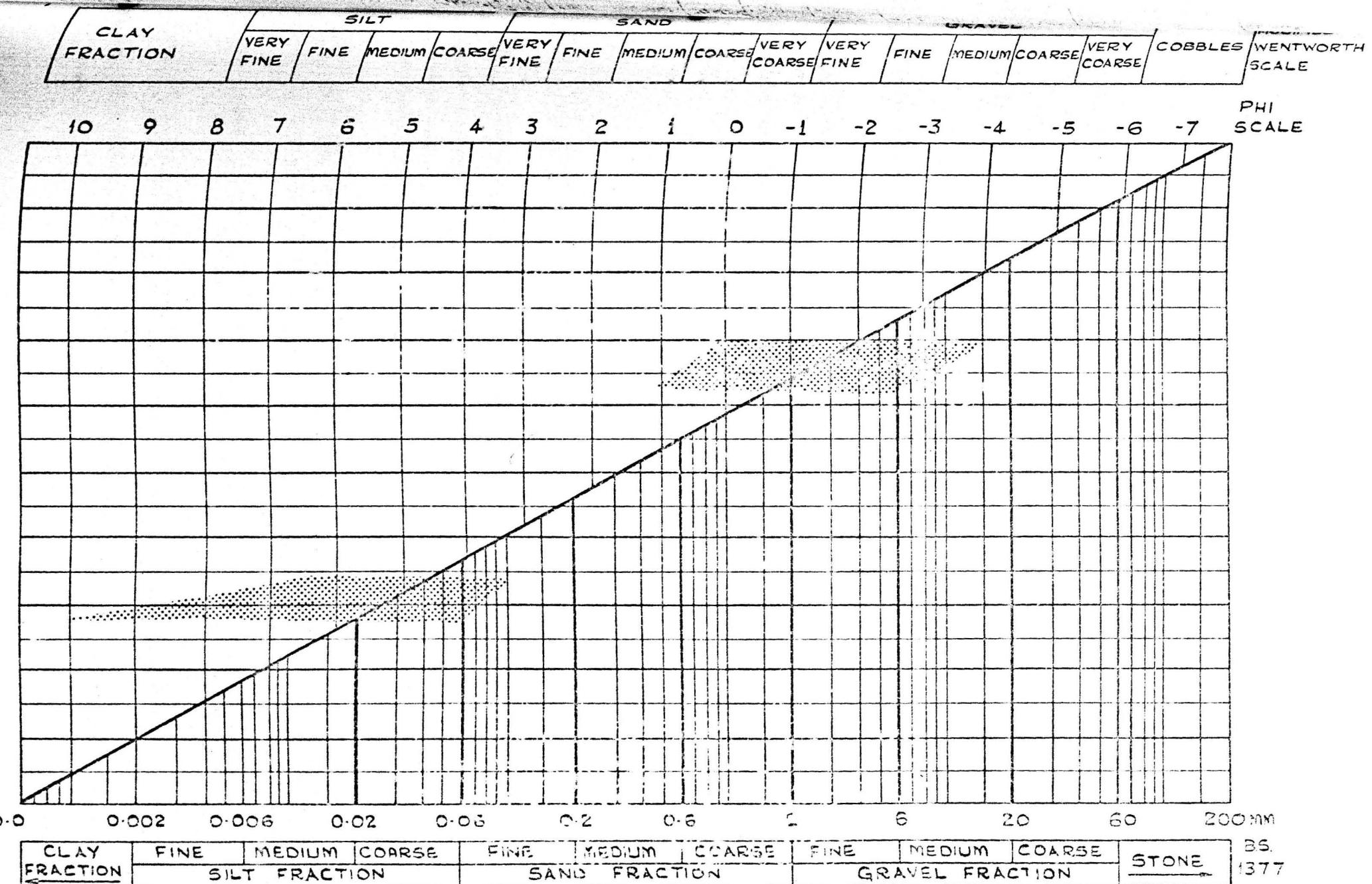


FIG.5.74. TEXTURAL CLASSIFICATION BASED ON  $Q_1$ ,  $M_d$ ,  $Q_2$  FOR BACKWATER UPPER SILTY TILL.

PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT

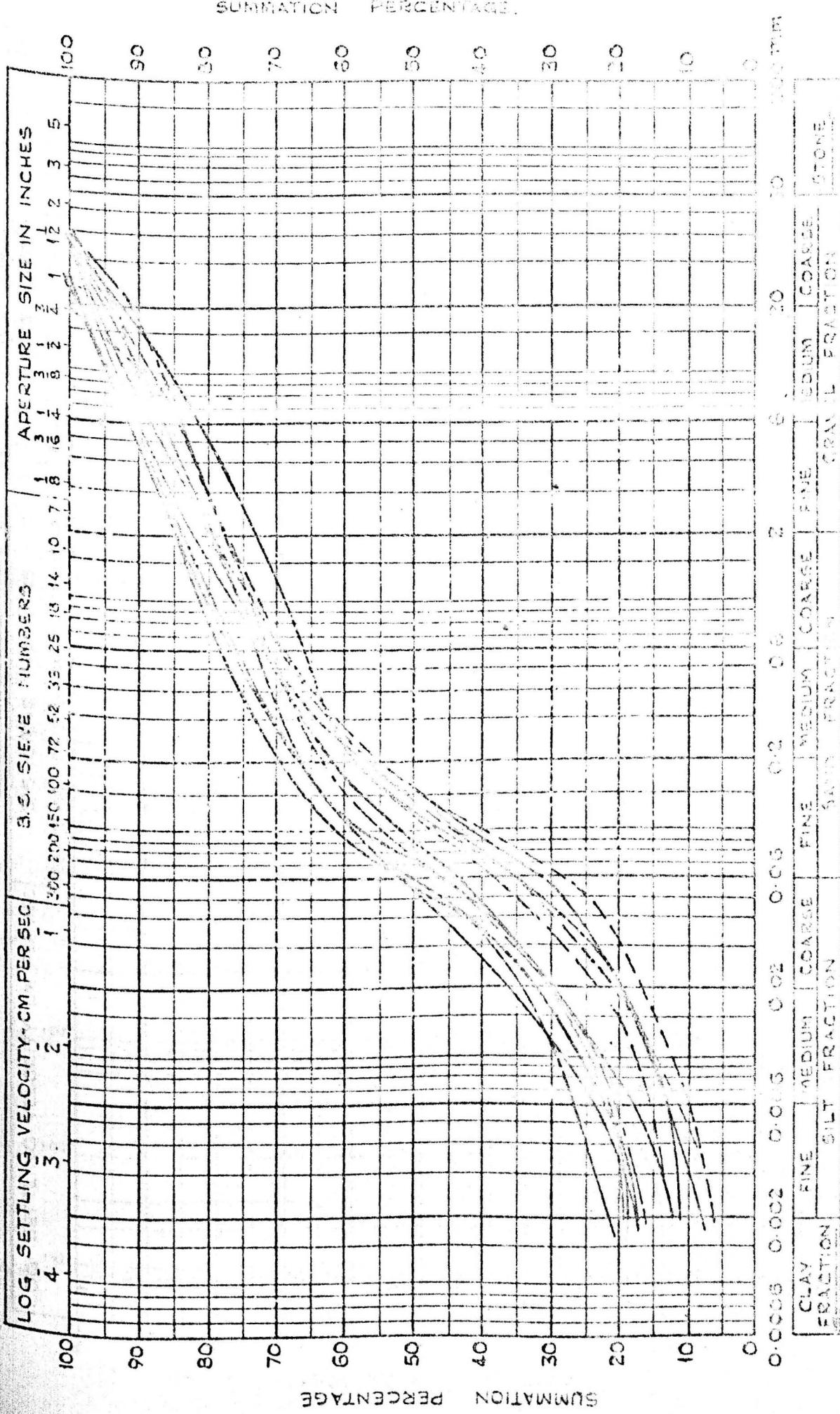


FIG. 5.75. GRADINGS FOR BACKWATER DATA NORMALIZED TO 100%.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

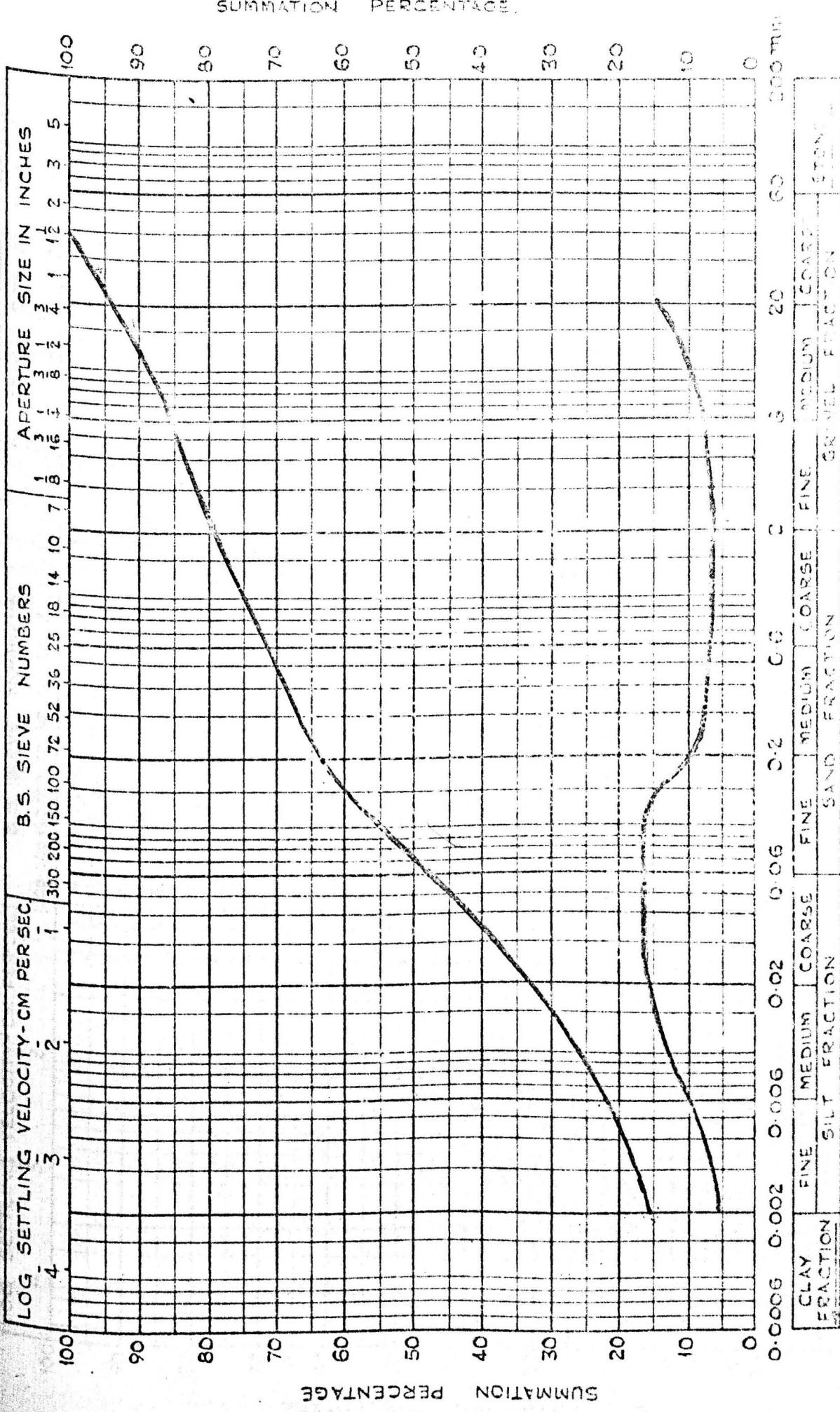


FIG. 5.76 BACKWATER DAM NORTH REAR TAIL - Plot Showing Cumulative and Frequency Curves.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

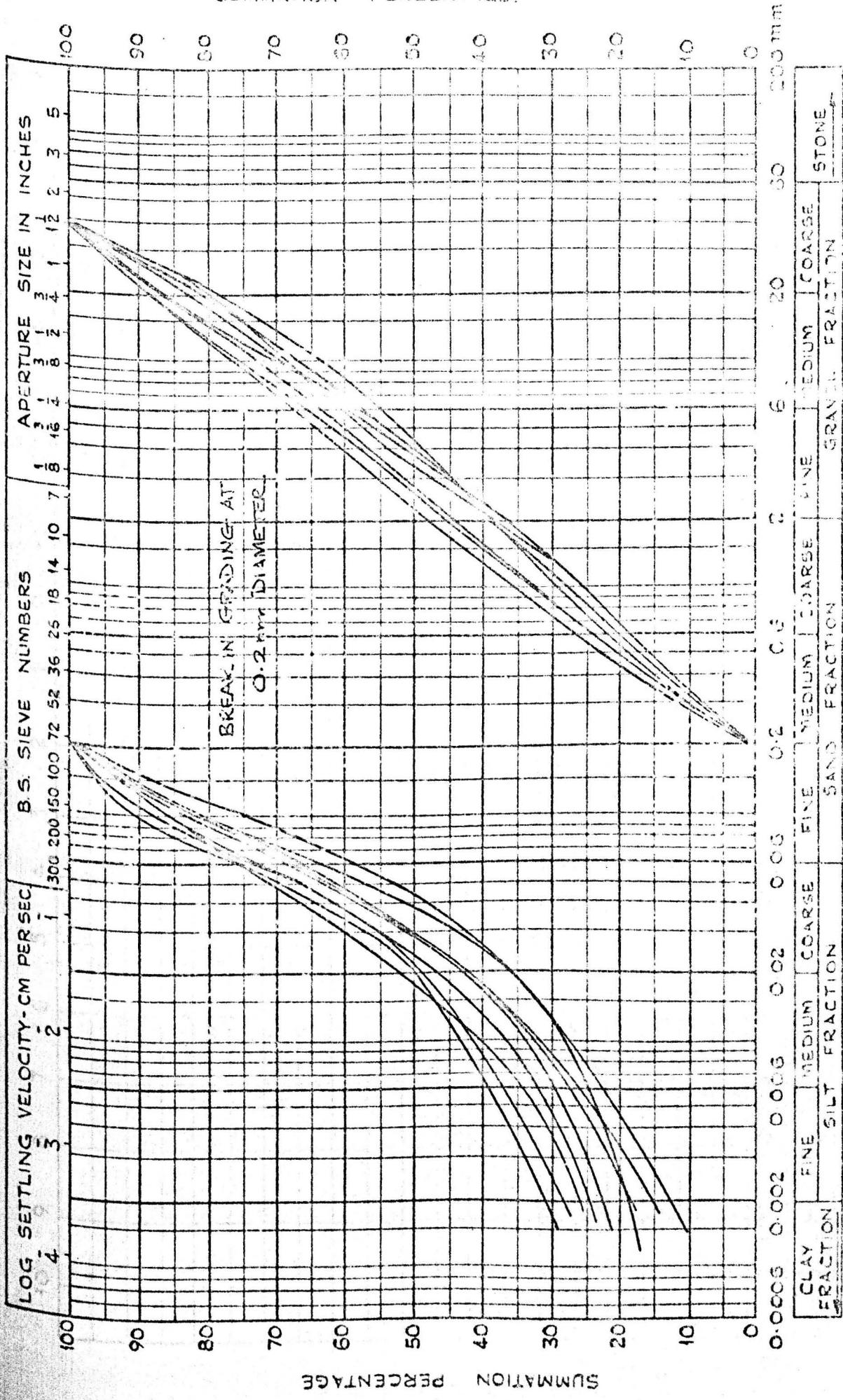


FIG. 5.77 SIZE FRACTIONS FOR BACKWATER DRY NORTH DEPOSIT TILLS

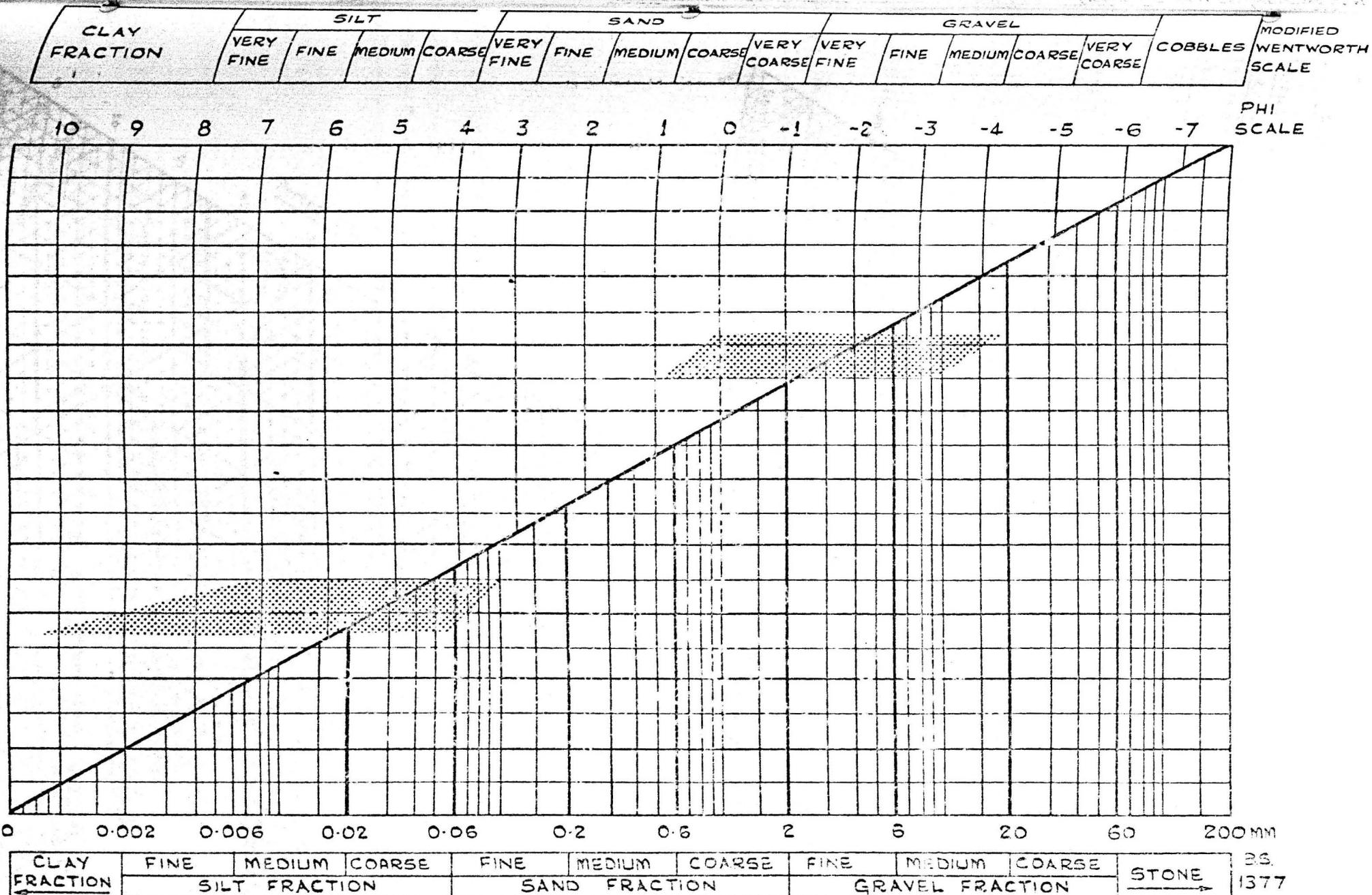


FIG. 5.7B: TEXTURAL CLASSIFICATION BASED ON  $Q_1$ ,  $M_4$ ,  $Q_3$  FOR BACKWATER DAM NORTH DEPOSIT THLS

FIG. 5.79.

TRIANGULAR DIAGRAMS  
FOR COWAL AND CORROUR  
TILL-GRADINGS OF  
FINE FRACTIONS.

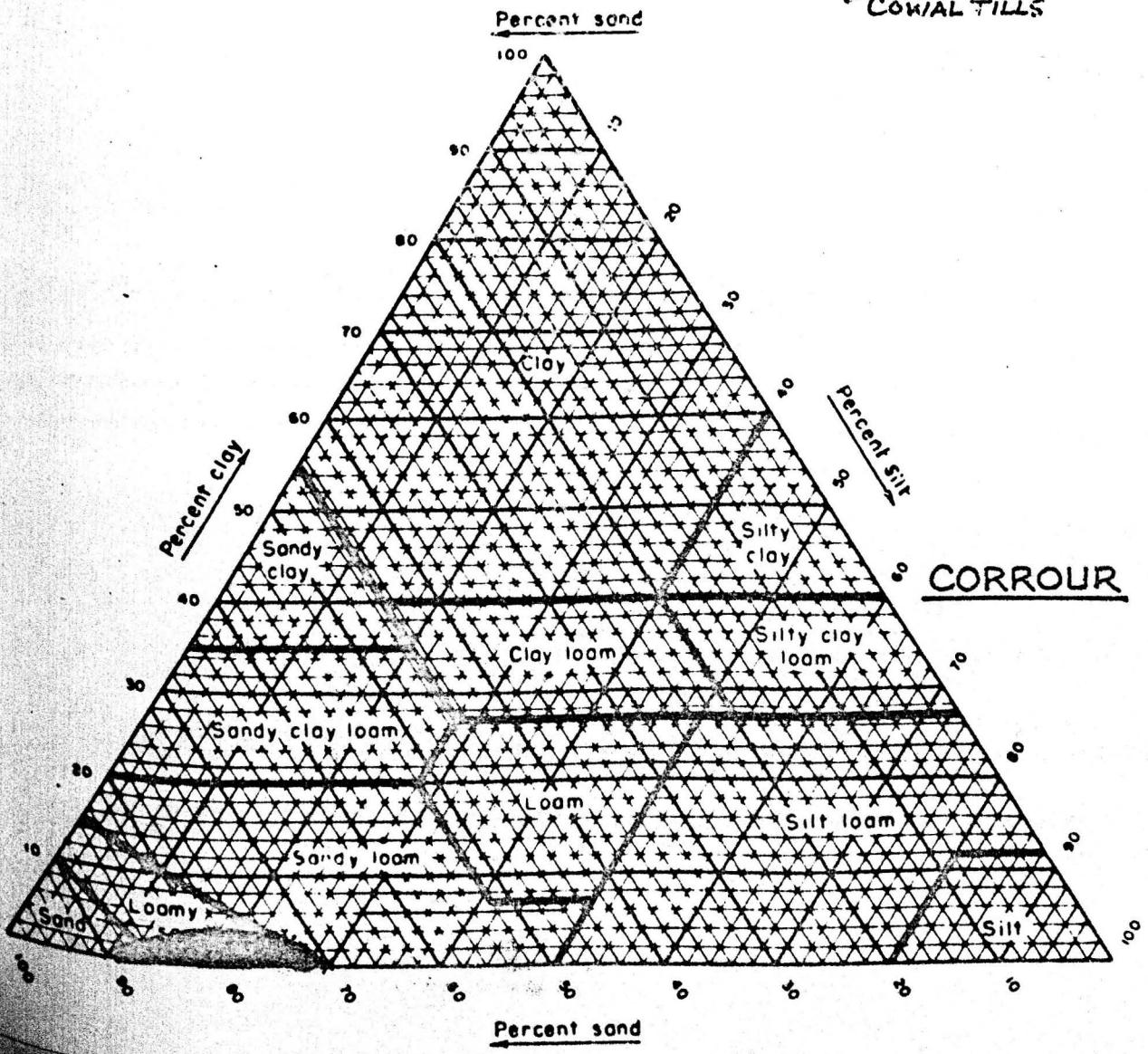
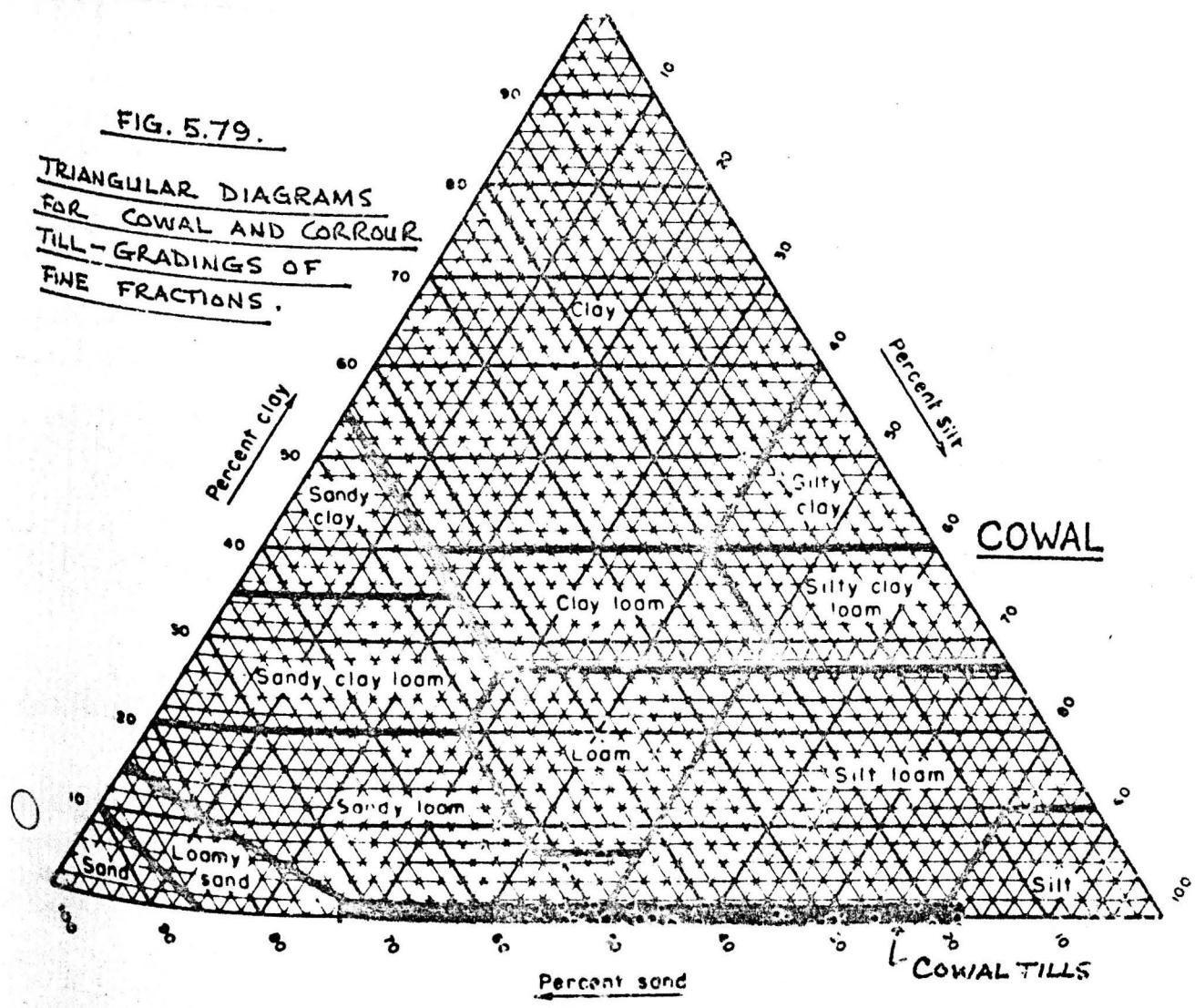
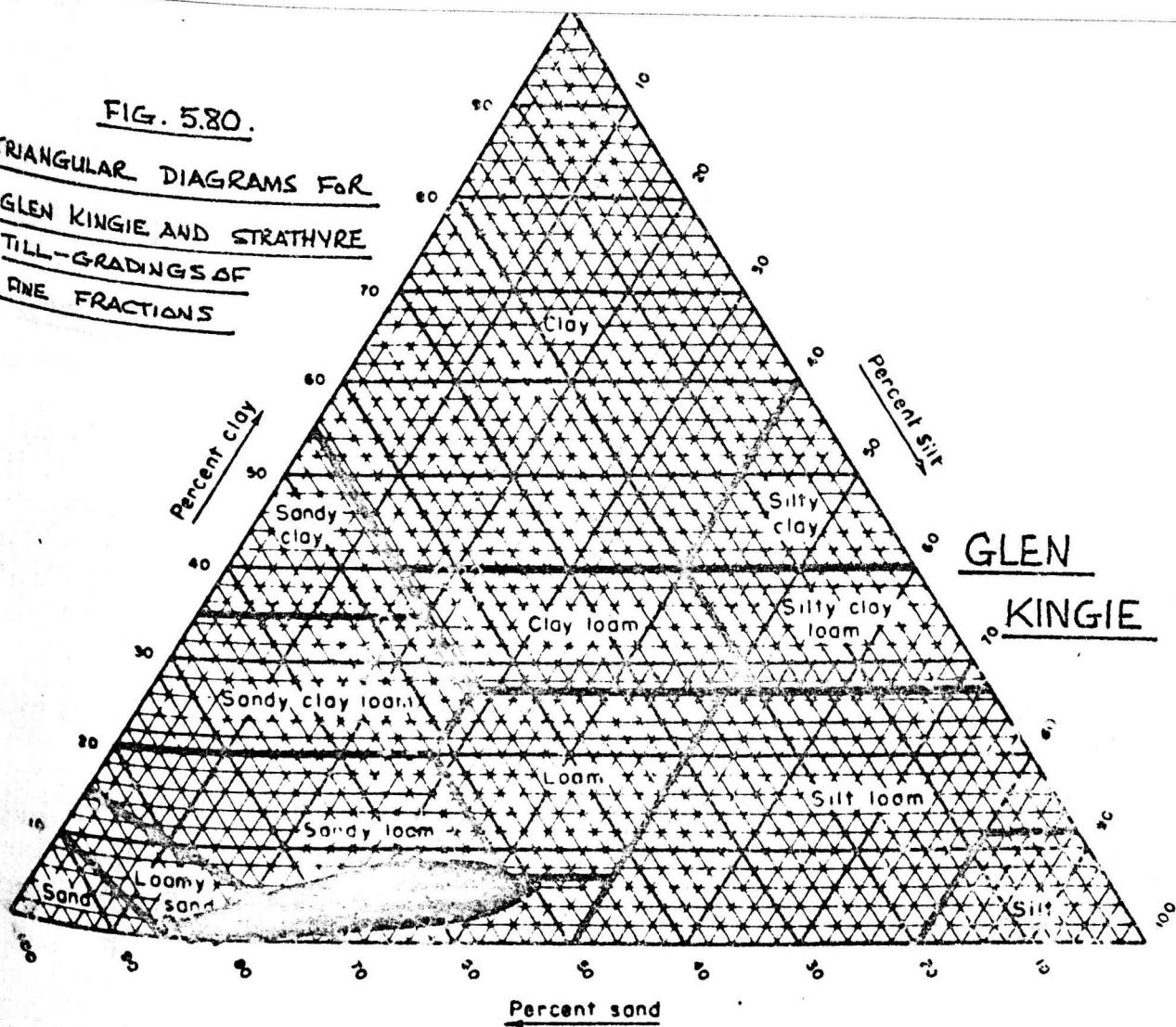
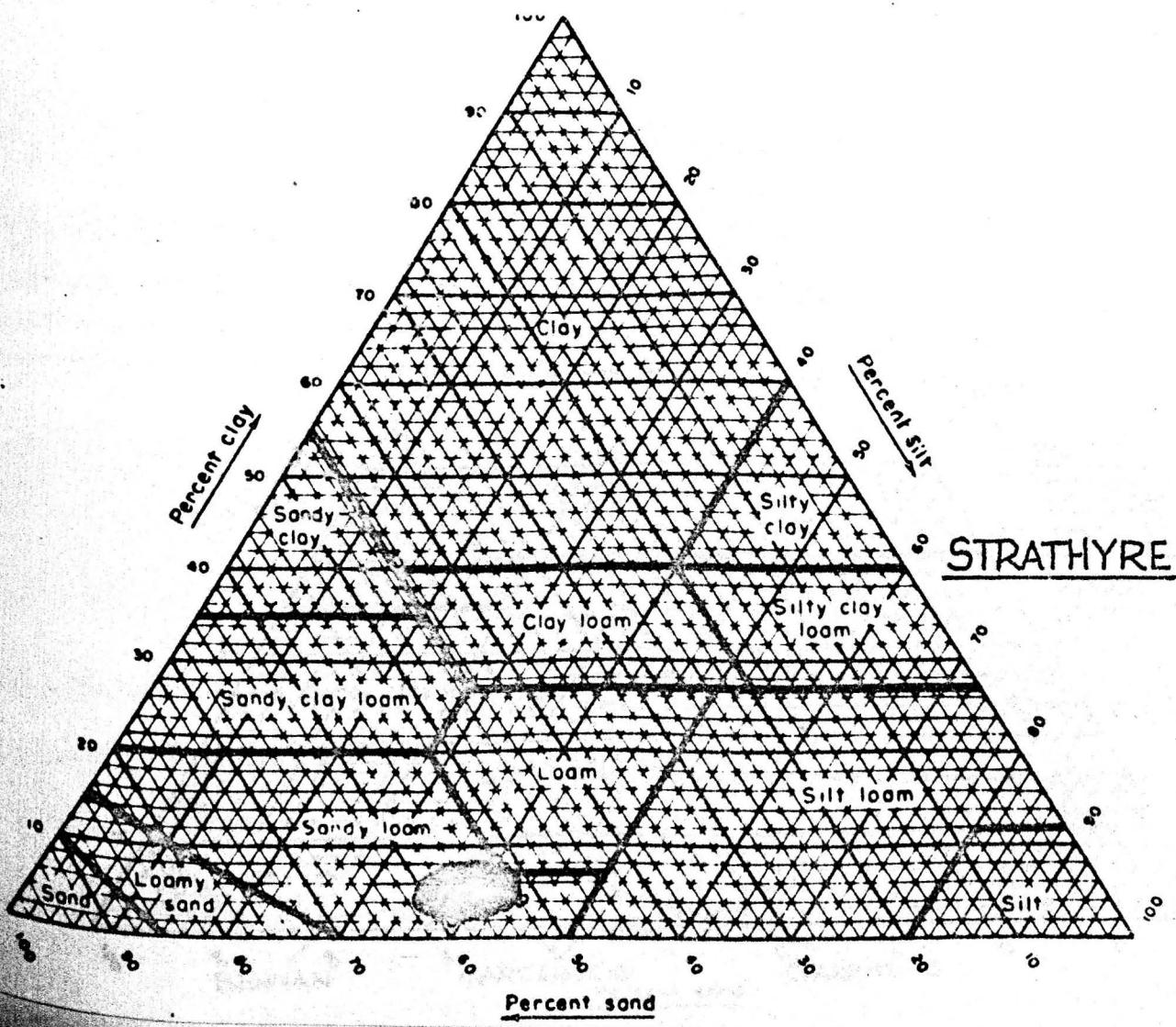


FIG. 5.80.  
 TRIANGULAR DIAGRAMS FOR  
 GLEN KINGIE AND STRATHYRE  
 TILL-GRADINGS OF  
 FINE FRACTIONS



GLEN  
KINGIE



STRATHYRE

FIG. 5.81.

TRIANGULAR DIAGRAMS FOR  
GLEN ORCHY AND GLEN TROOL  
TILLS - GRADINGS OF  
FINE FRACTIONS

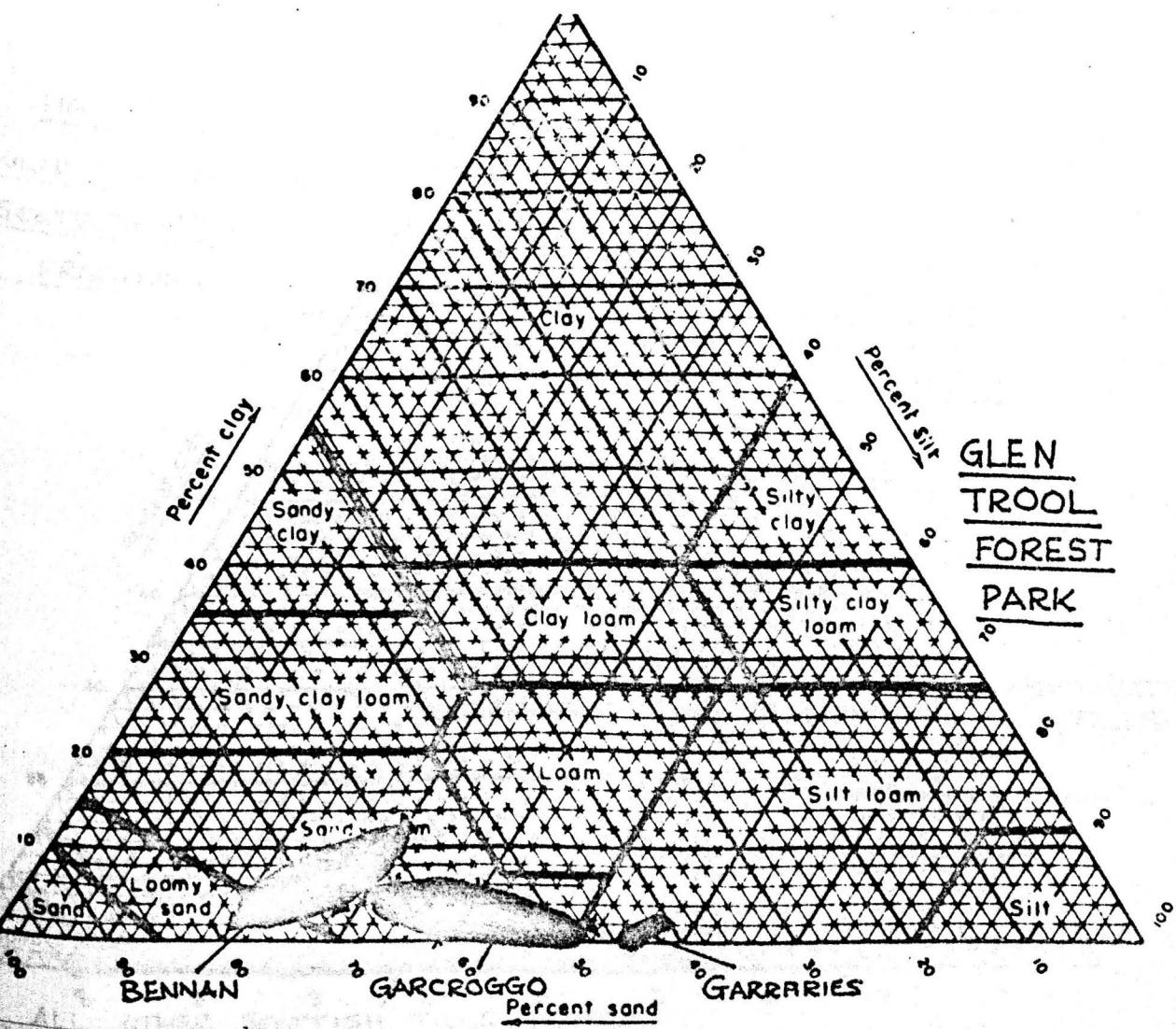
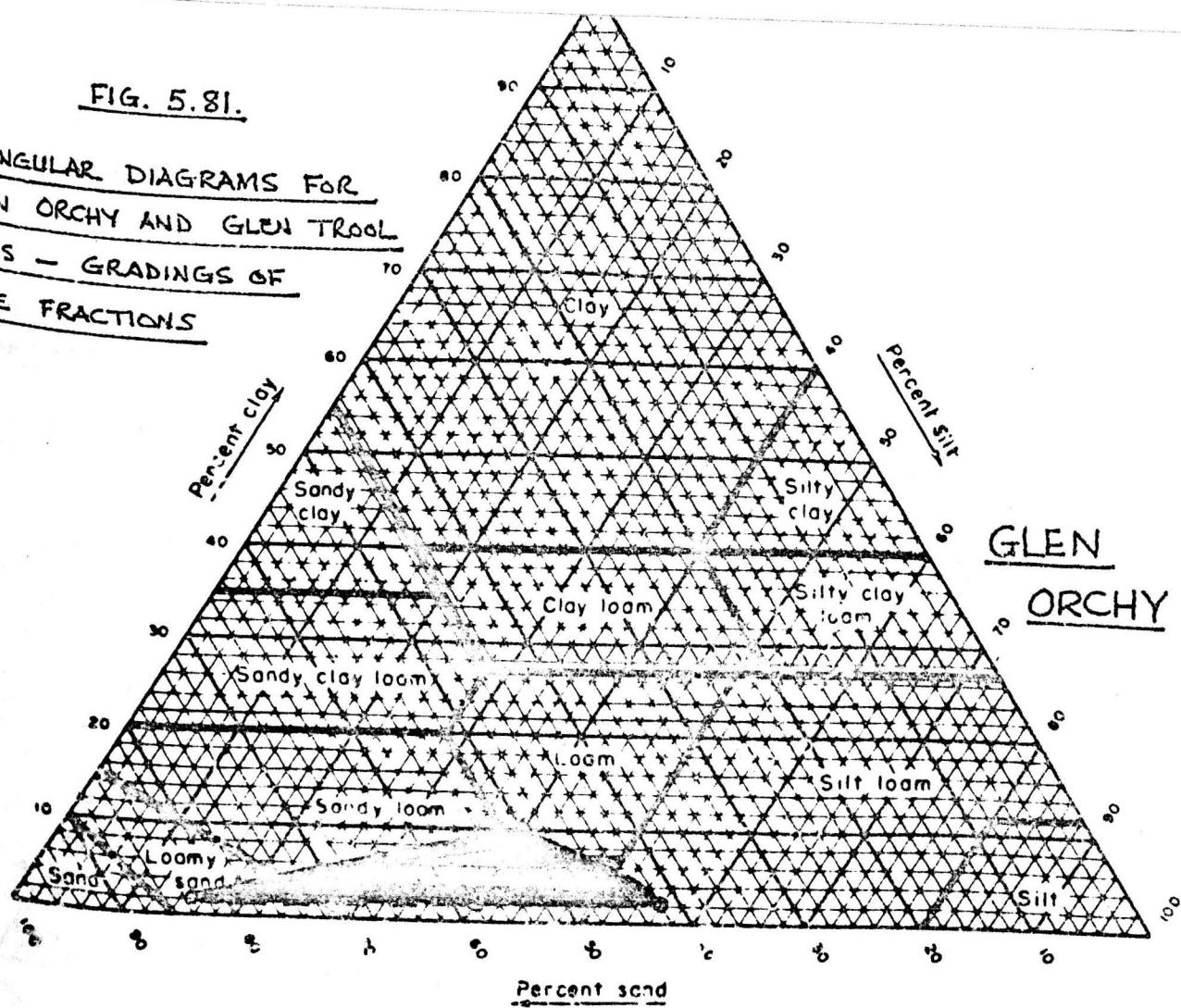


FIG. 5.82.

TRIANGULAR DIAGRAM FOR  
BACKWATER TILLS FINE  
FRACTIONS

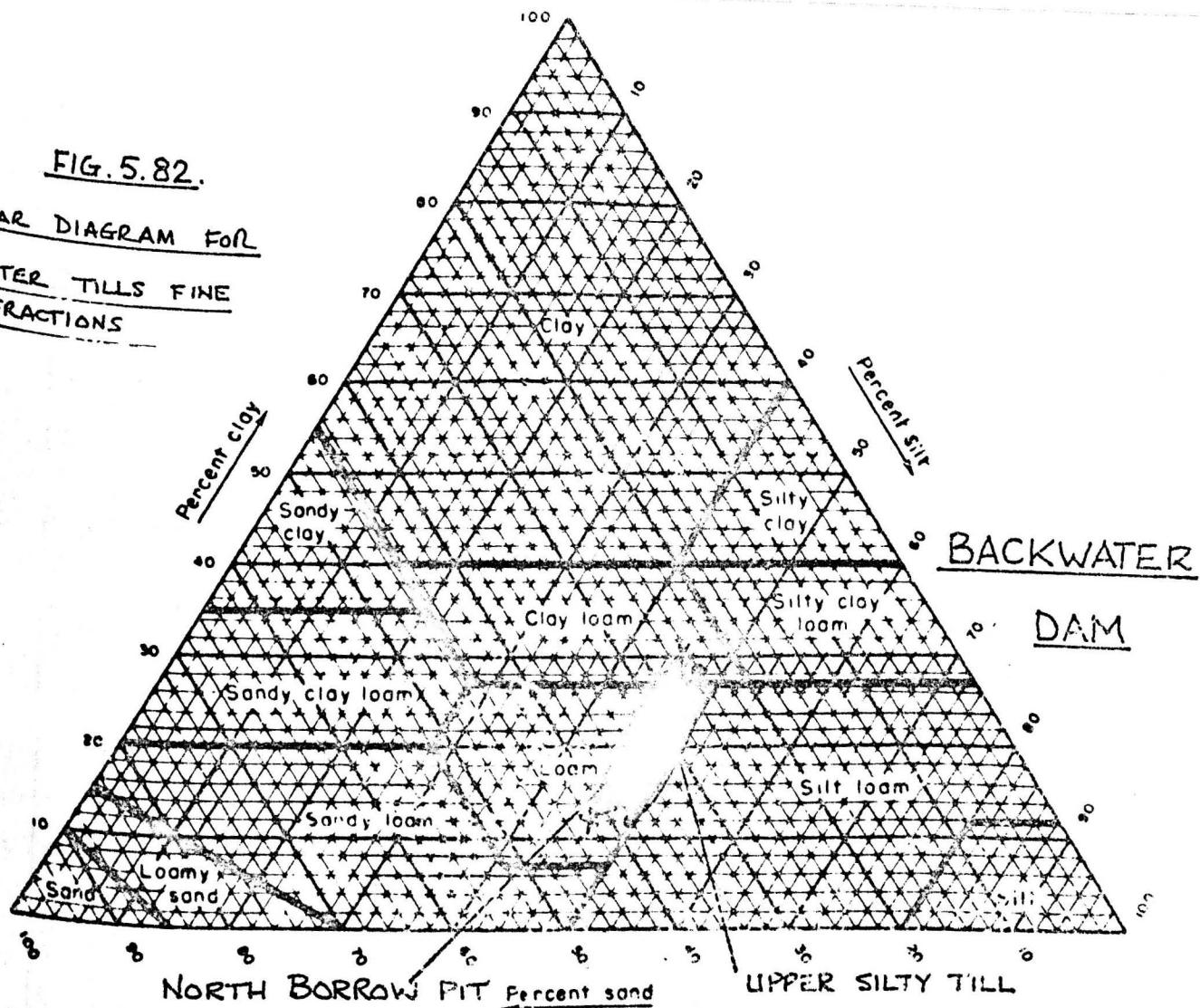
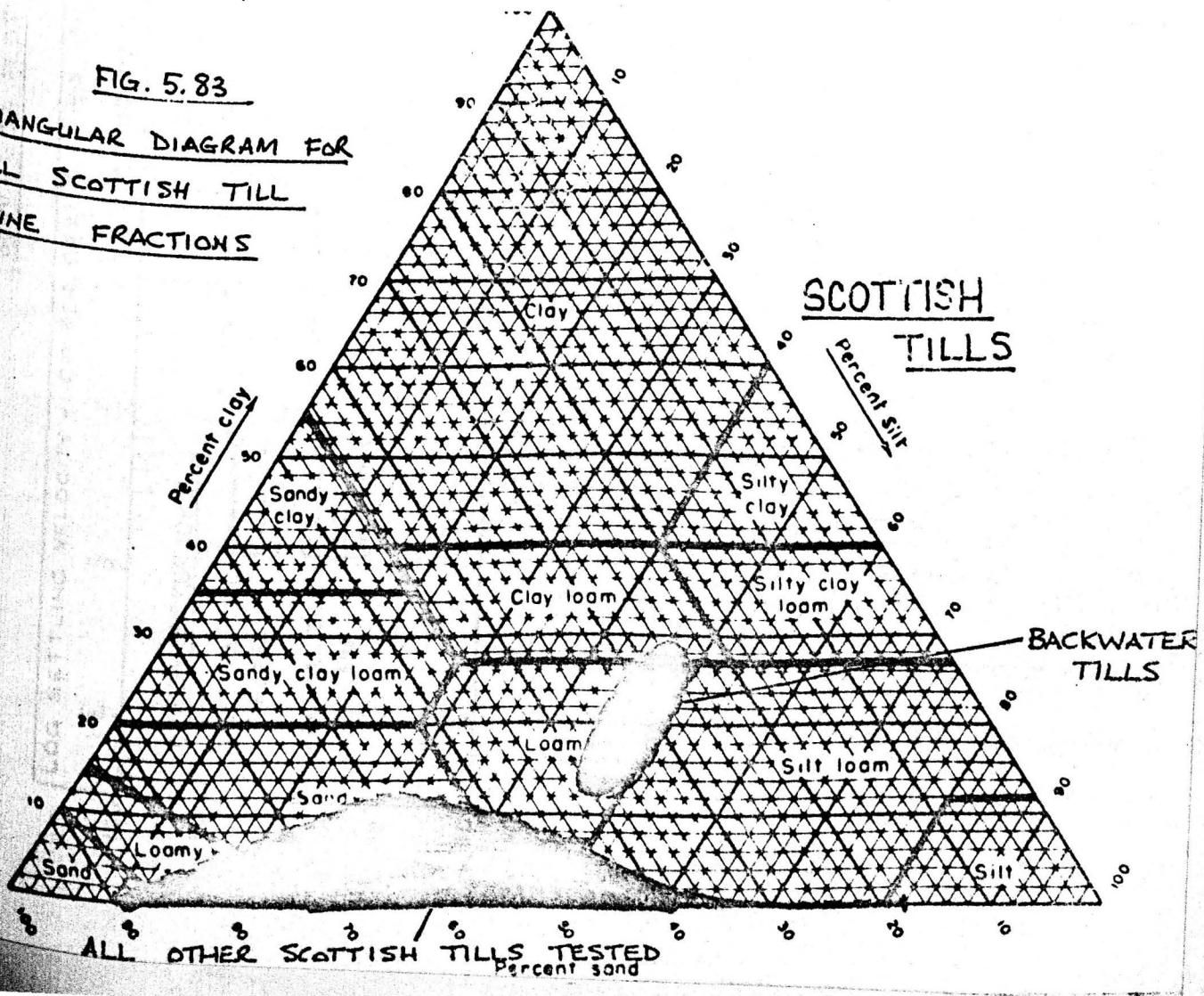


FIG. 5.83

TRIANGULAR DIAGRAM FOR  
ALL SCOTTISH TILL  
FINE FRACTIONS



PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT

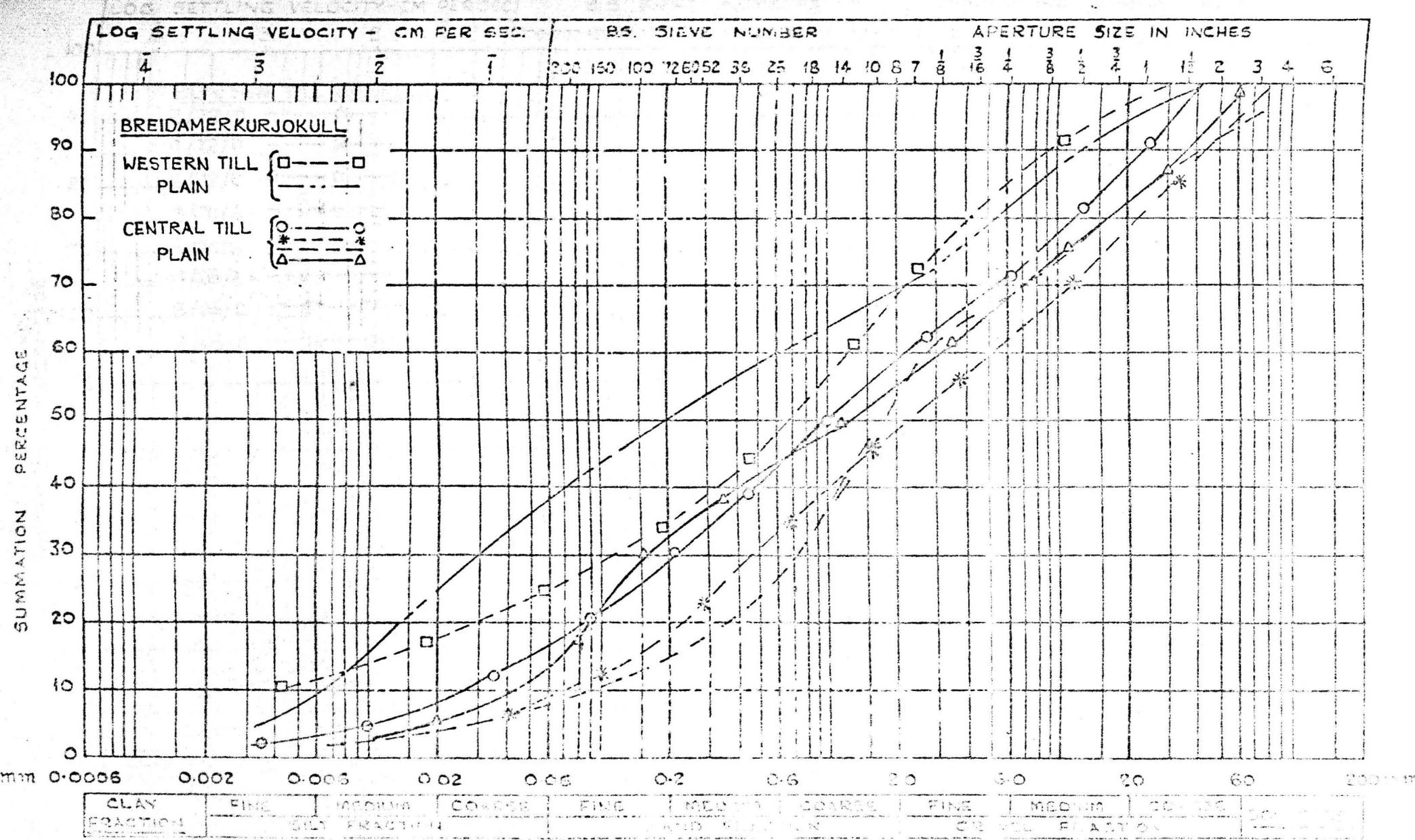
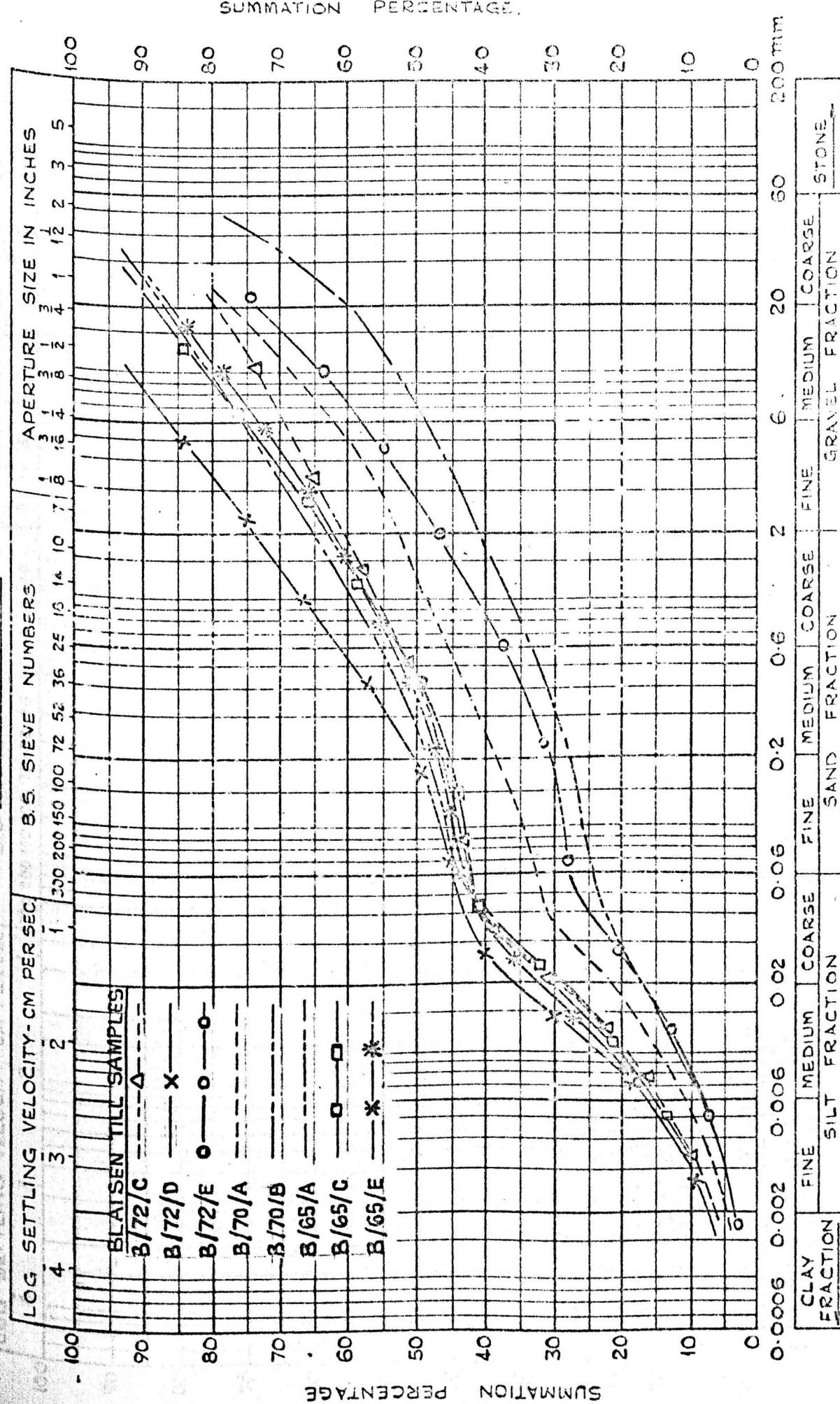


FIG. 5.84. GRADING FOR BREIDAMERKURJOKULL TILLS.

## PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT



PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT

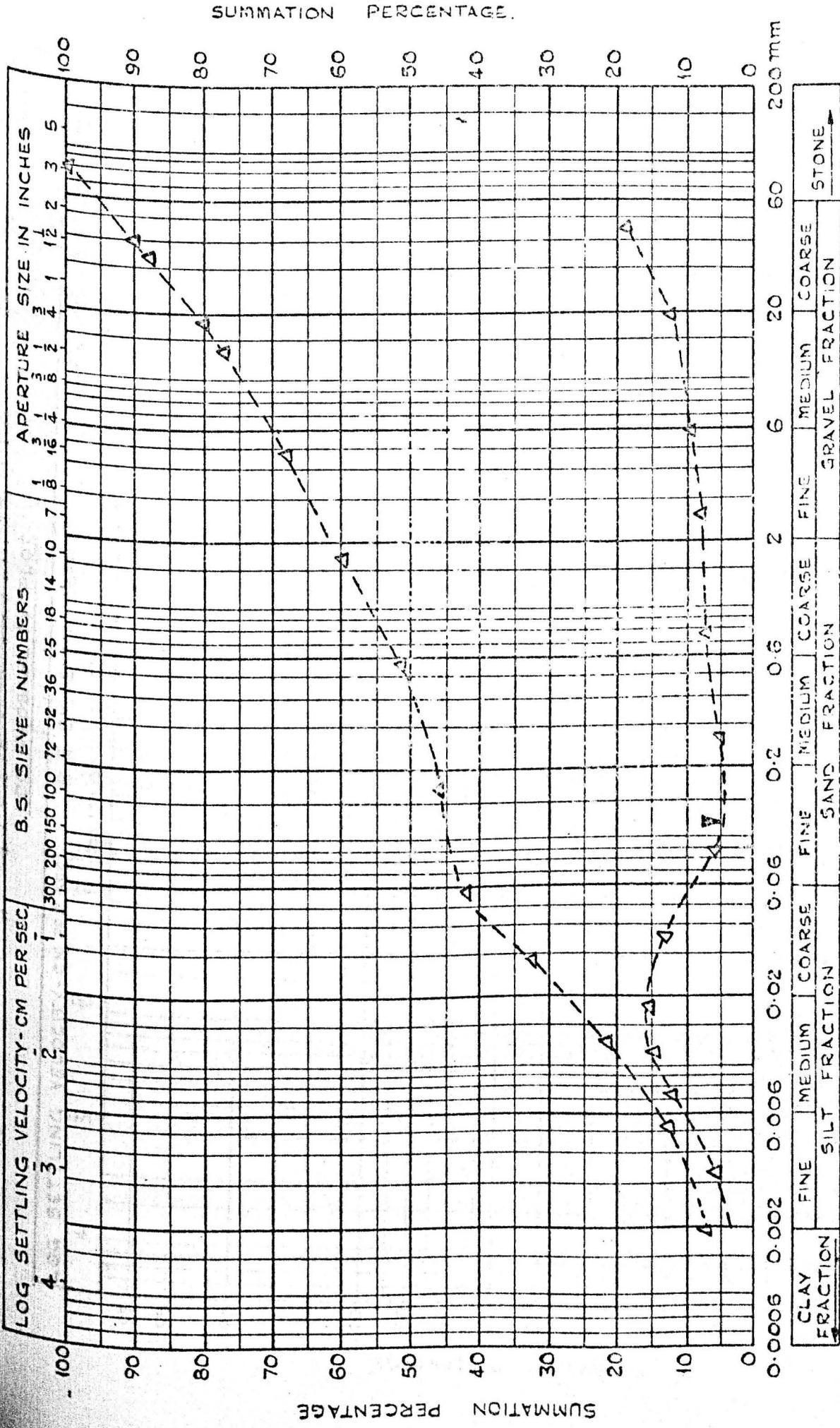


FIG. 5.86 BLAISEA TILL - NOT SHOWING THE CUMULATIVE AND FREQUENCY DISTRIBUTION CURVES FOR SEDIMENT

PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT.

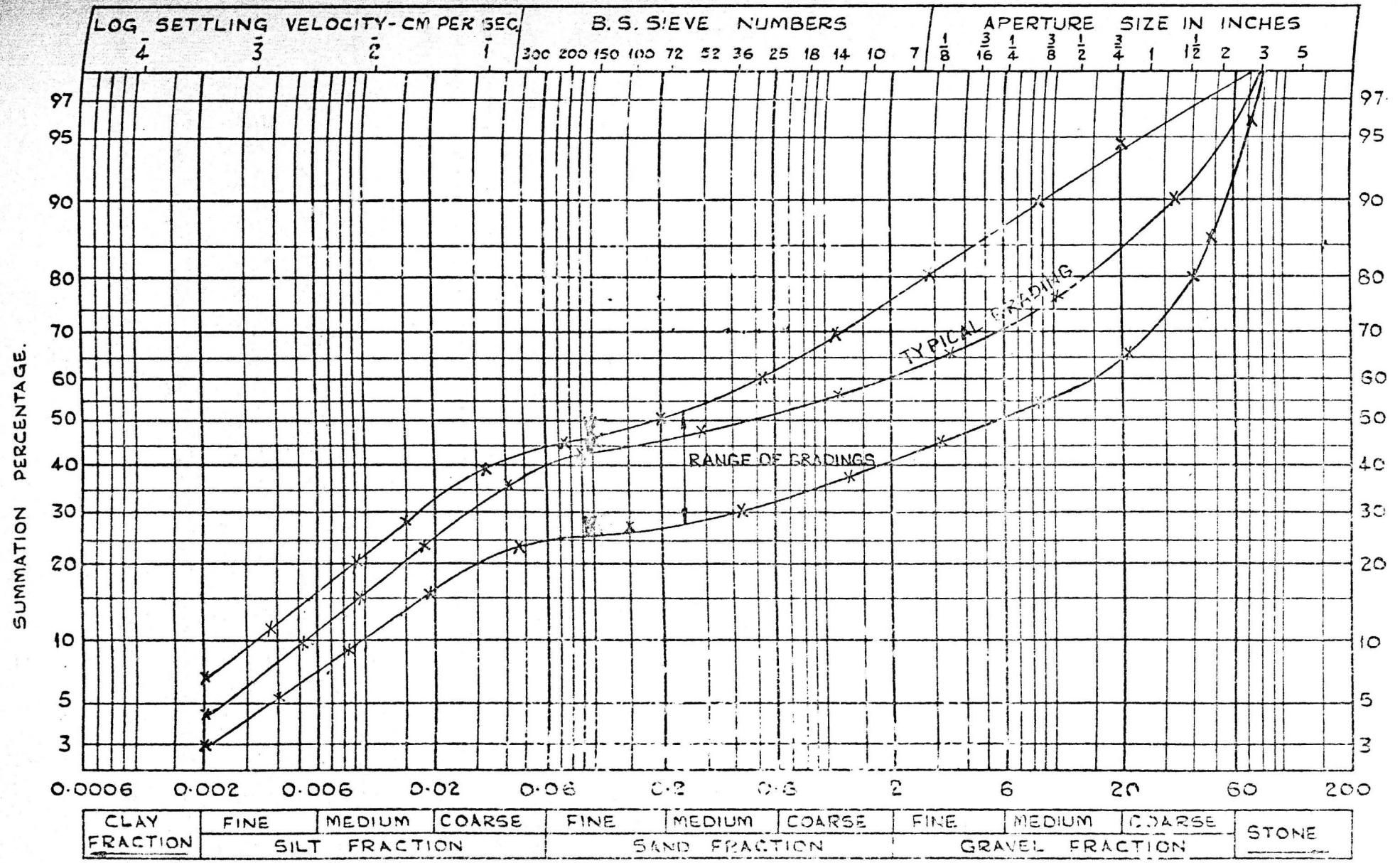


FIG. 5.87 LOG PROBABILITY PLOT OF BLAVERN TILL GRADING.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

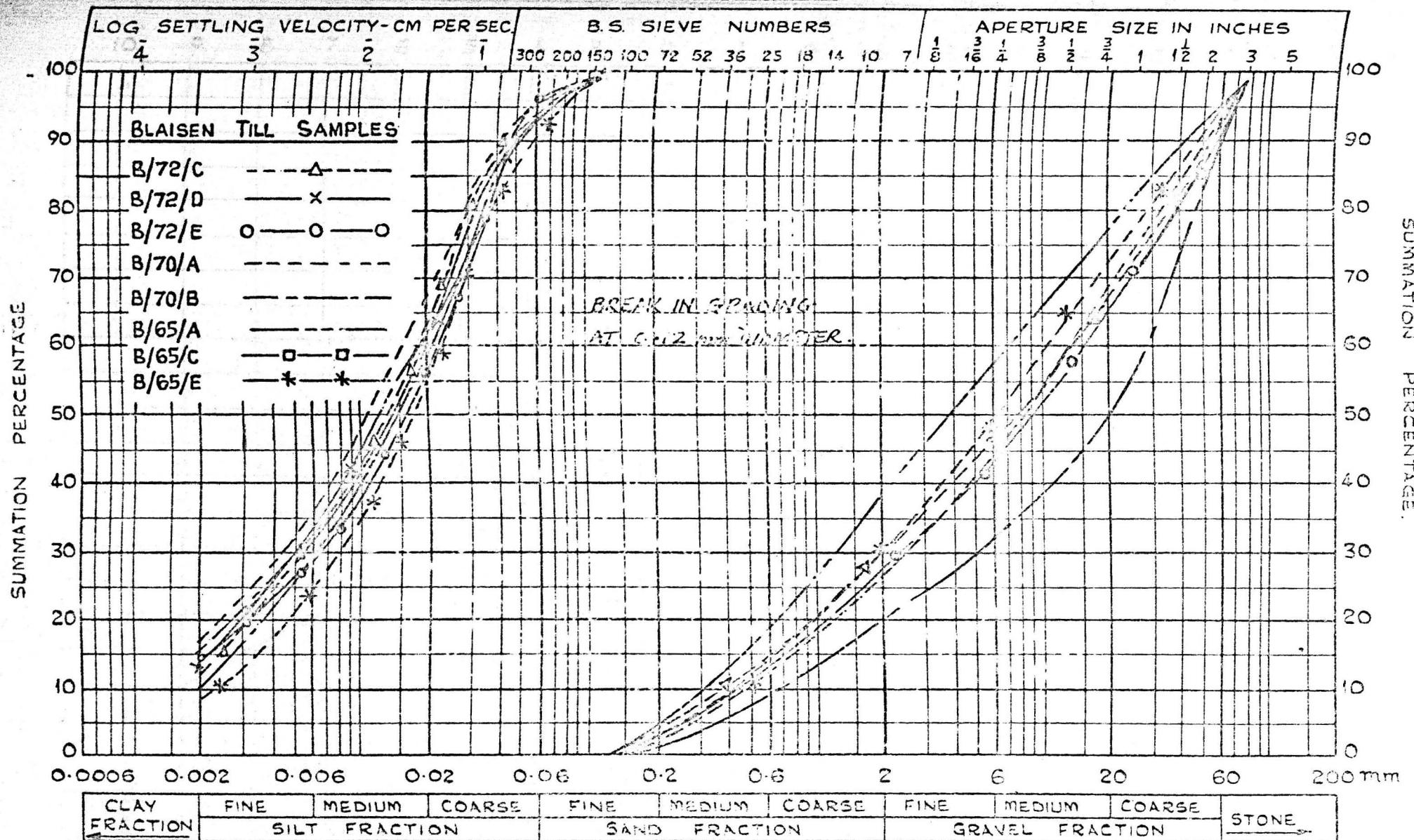


FIG. 5.88. SIZE FRACTIONS FOR BLAISEN TILLS.

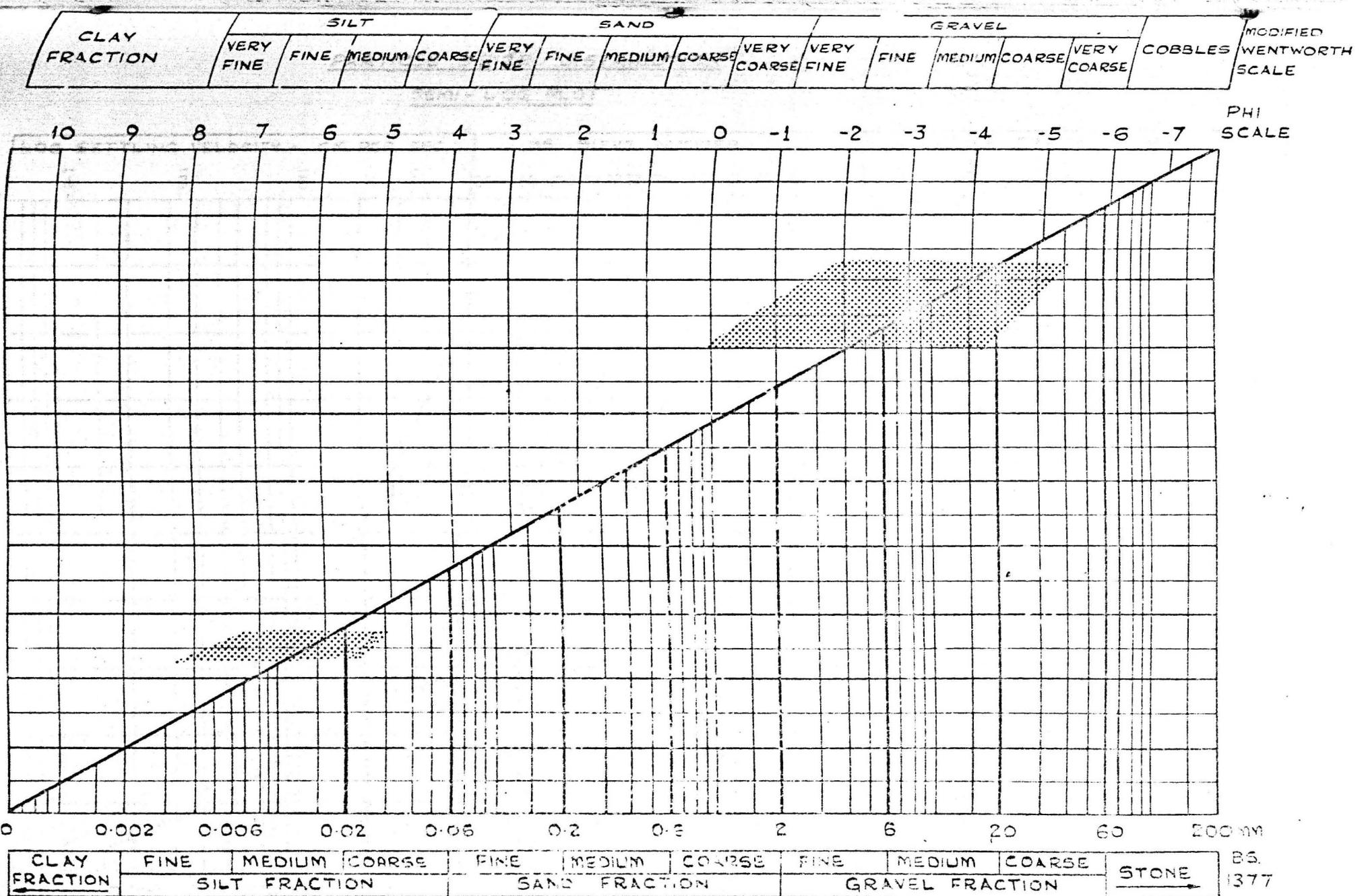


FIG. 5.89. TEXTURAL CLASSIFICATION BASED ON Q<sub>1</sub>, M<sub>3</sub>, Q<sub>3</sub> FOR BLISTEN TILL

PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT

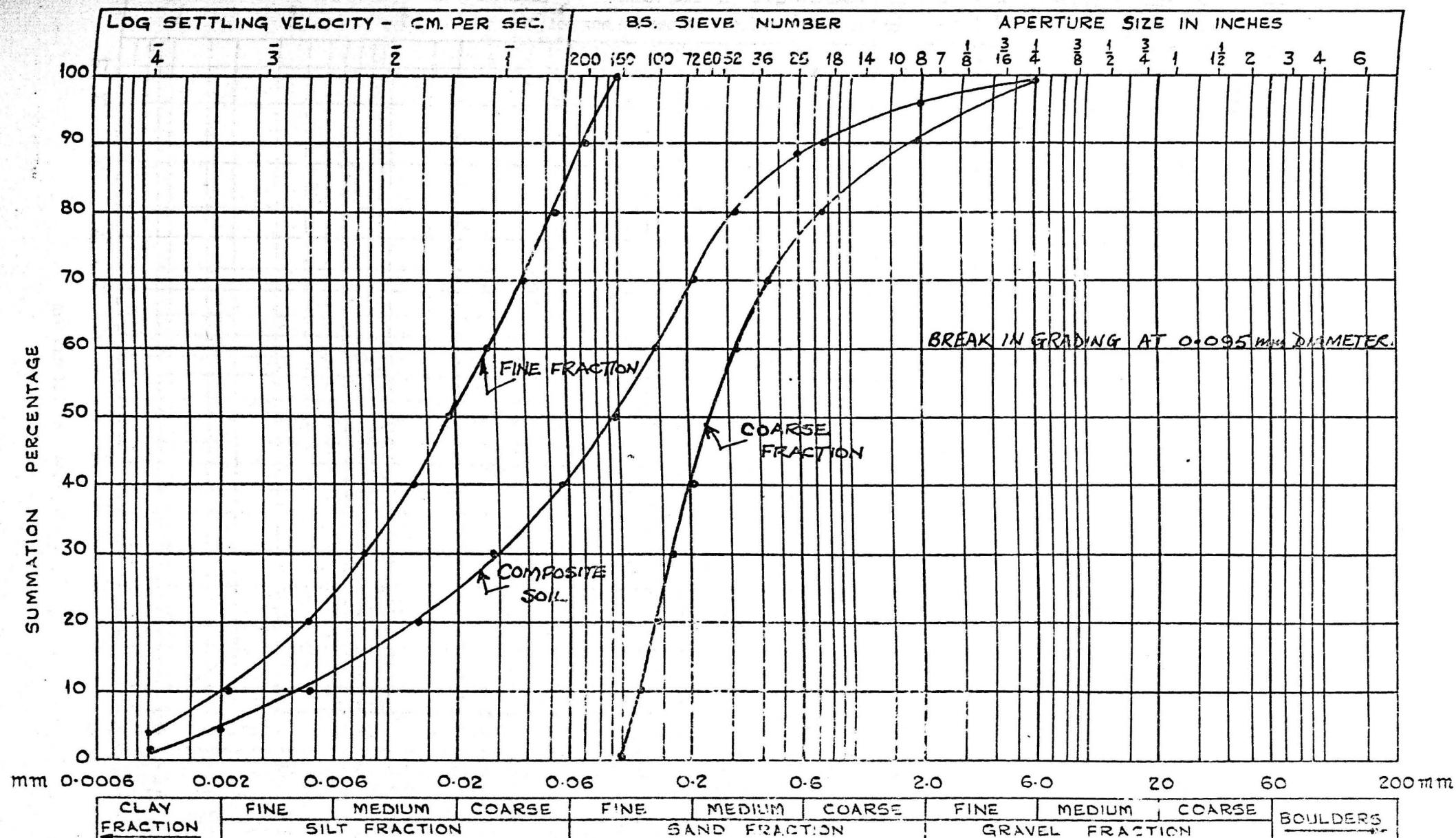


FIG 5.90. SIZE FRACTIONS FOR ANTARCTICA TILL.

PARTICLE SIZE DISTRIBUTION

LOG PROBABILITY PLOT.

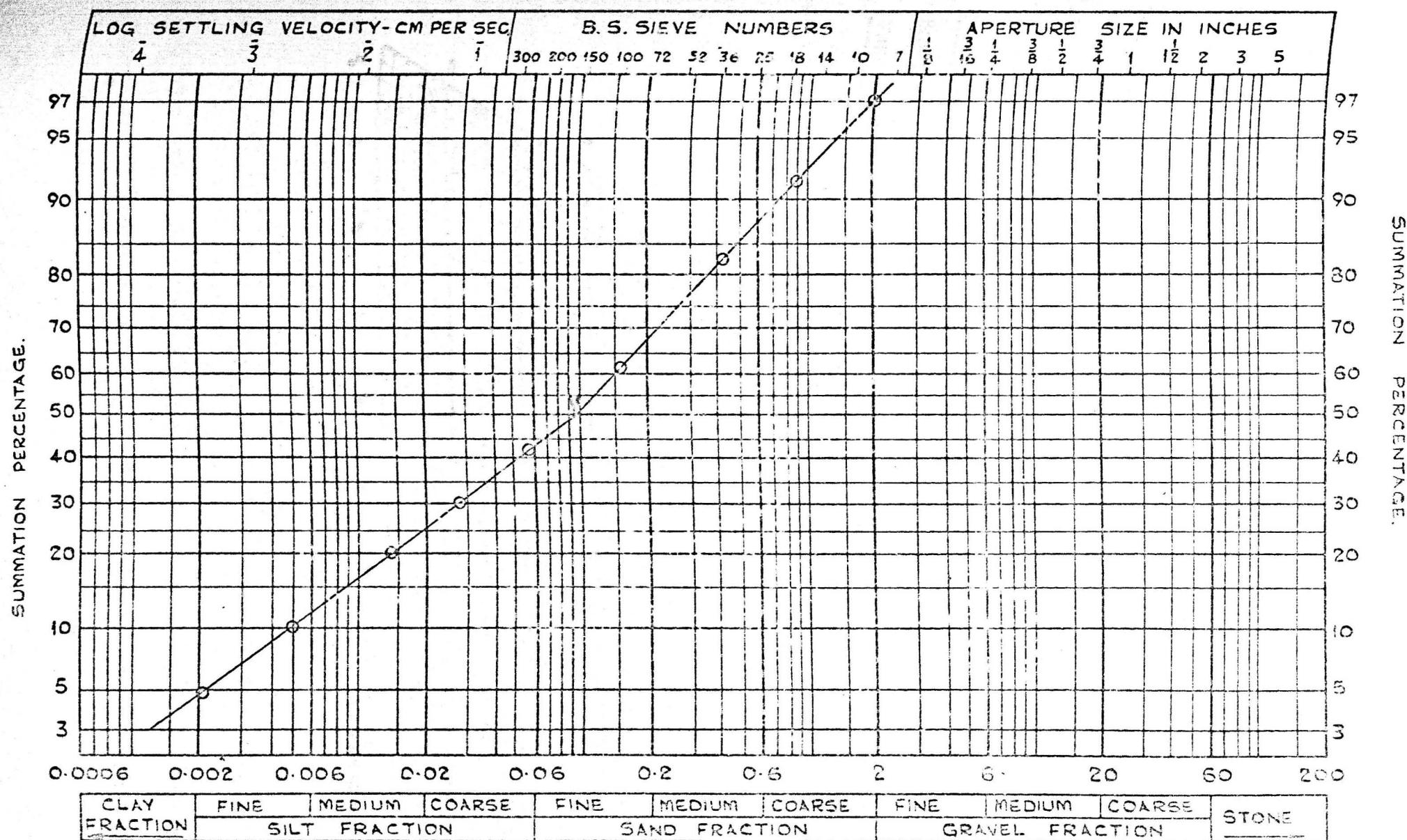
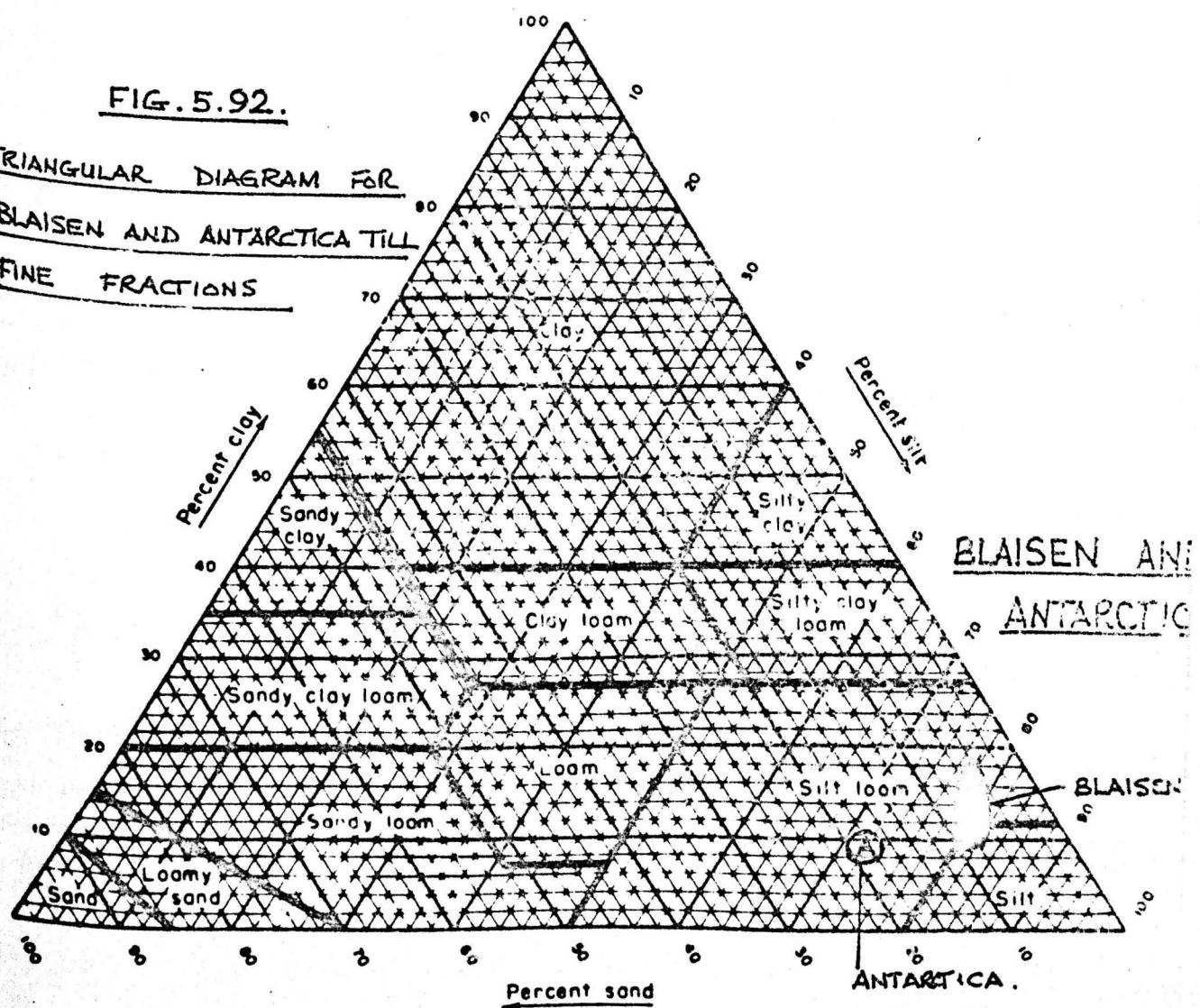


FIG. 5.91 LOG PROBABILITY PLOT FOR ANTARCTICA TILL

FIG. 5.92.

TRIANGULAR DIAGRAM FOR  
BLAISEN AND ANTARCTICA TILL  
FINE FRACTIONS



PARTICLE SIZE DISTRIBUTION

SEMI - LOG PLOT

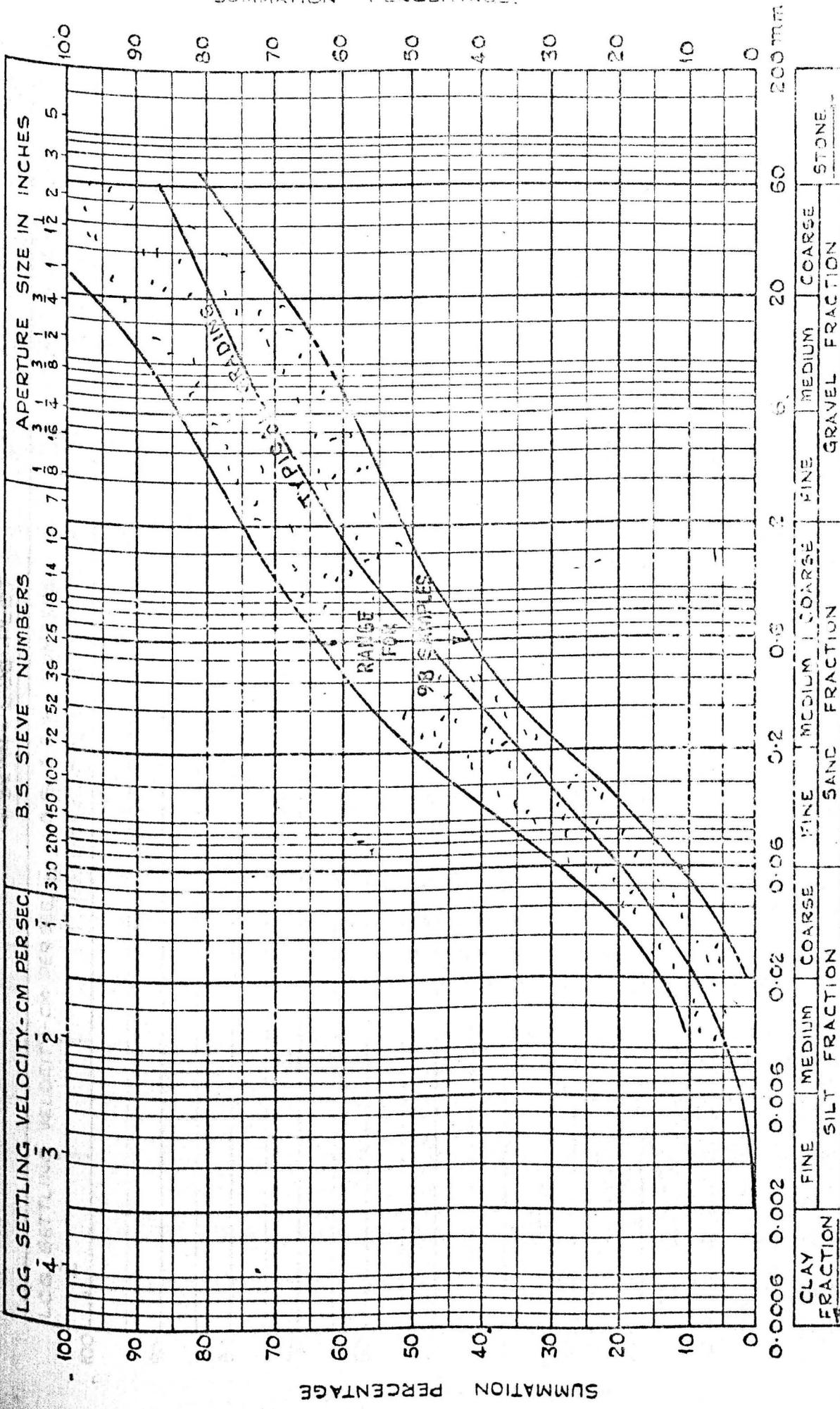


FIG 5.93 GRADINGS For BORDAL RUM TILL (2)

PARTICLE SIZE DISTRIBUTION  
SEMI - LOG PLOT

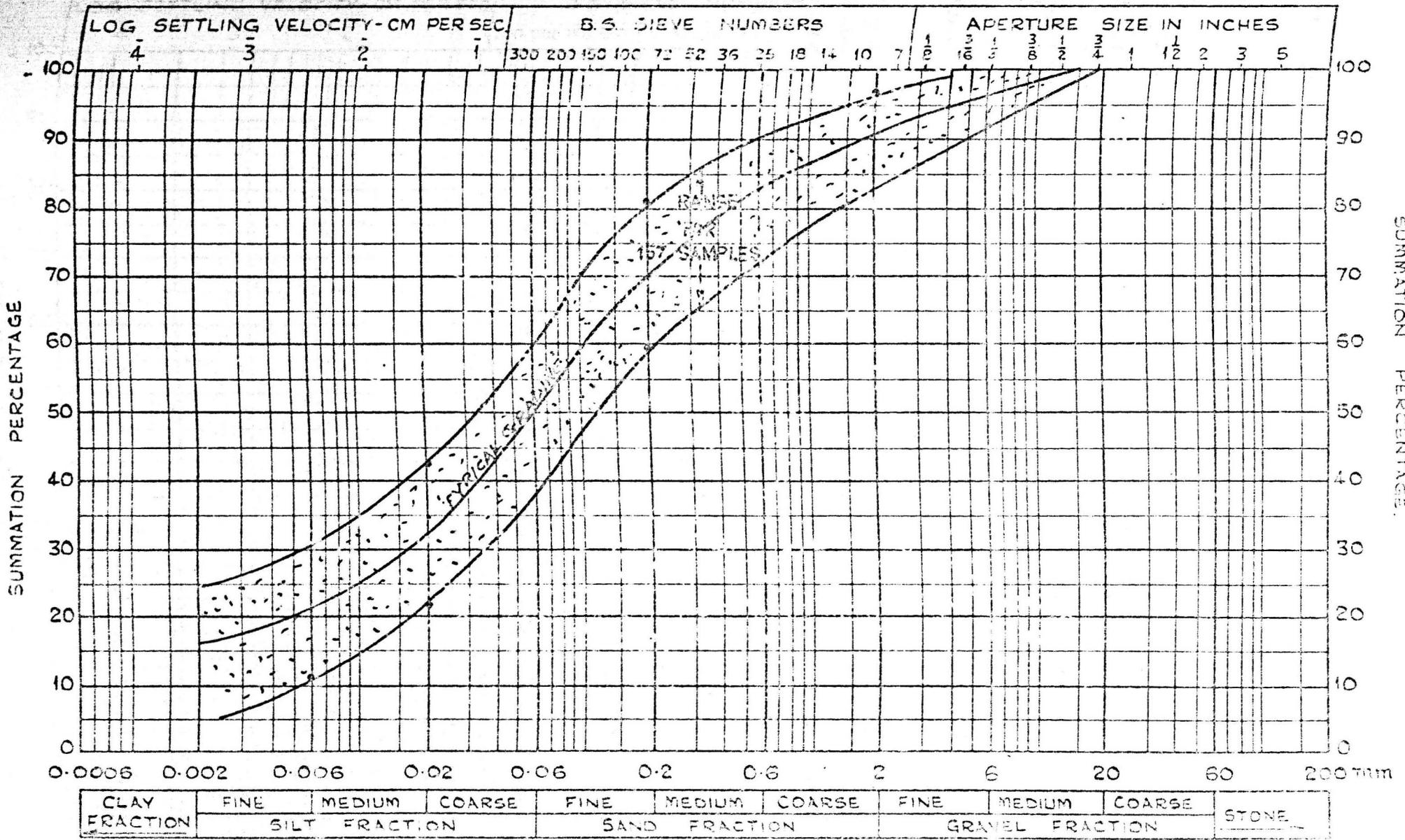


FIG. 5.94. GRADINGS FOR ARSTADDALEN DAM TILL (7)

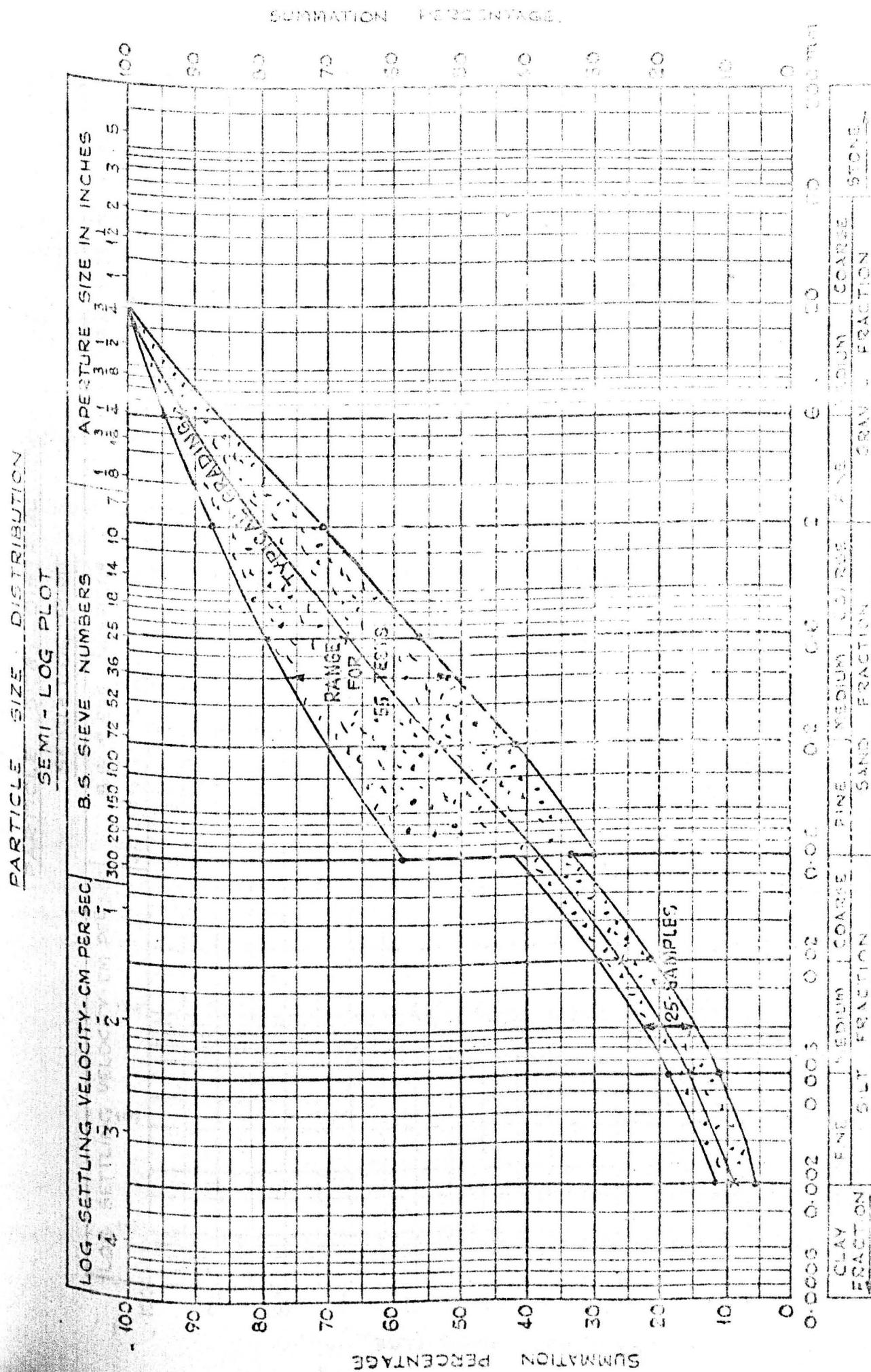


FIG. 5.95. GRAVINGS FOR TUNING DAY THREE (12)

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

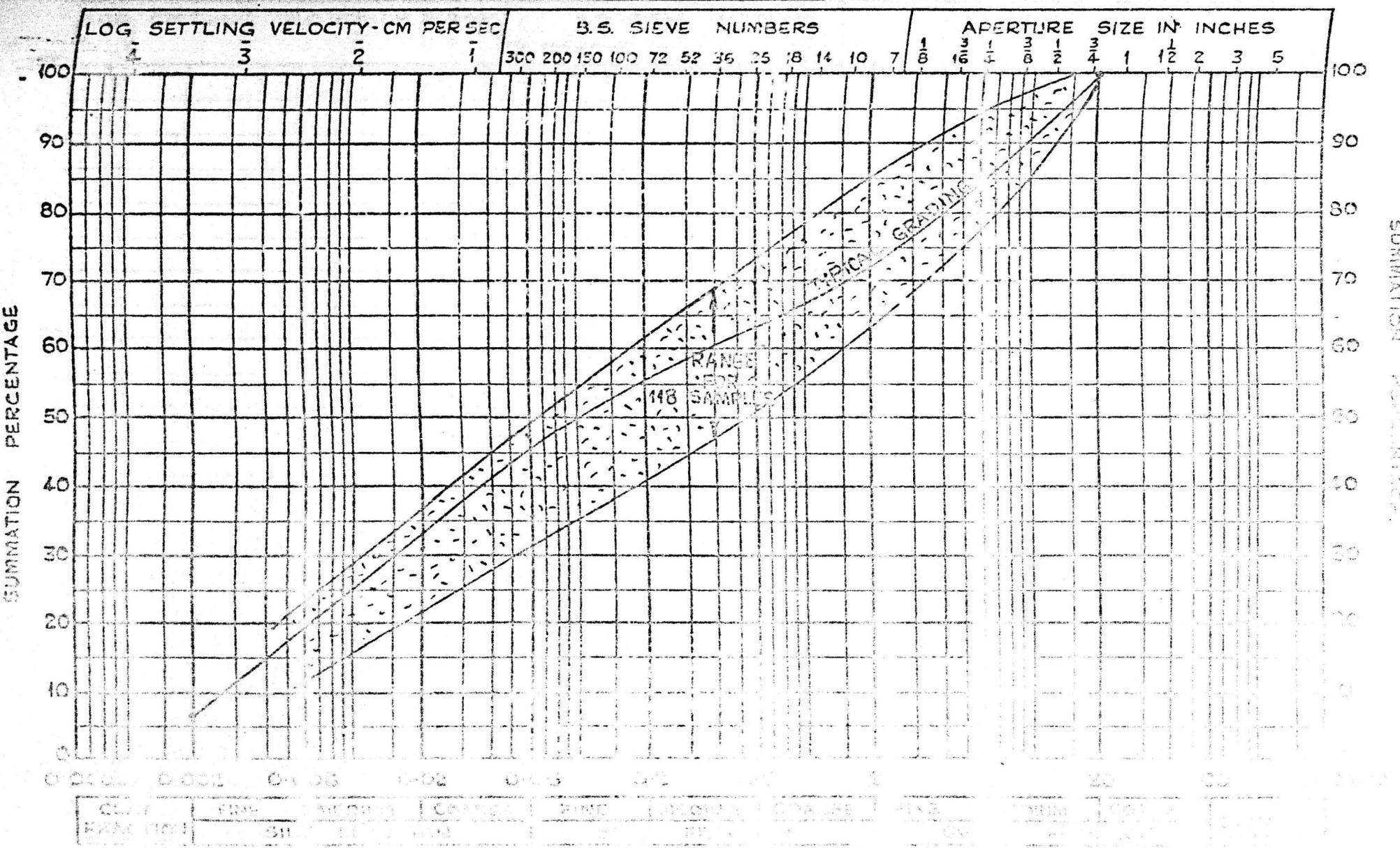


FIG. 20. GRAIN SIZE DISTRIBUTION FOR HYDRAULIC TEST

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

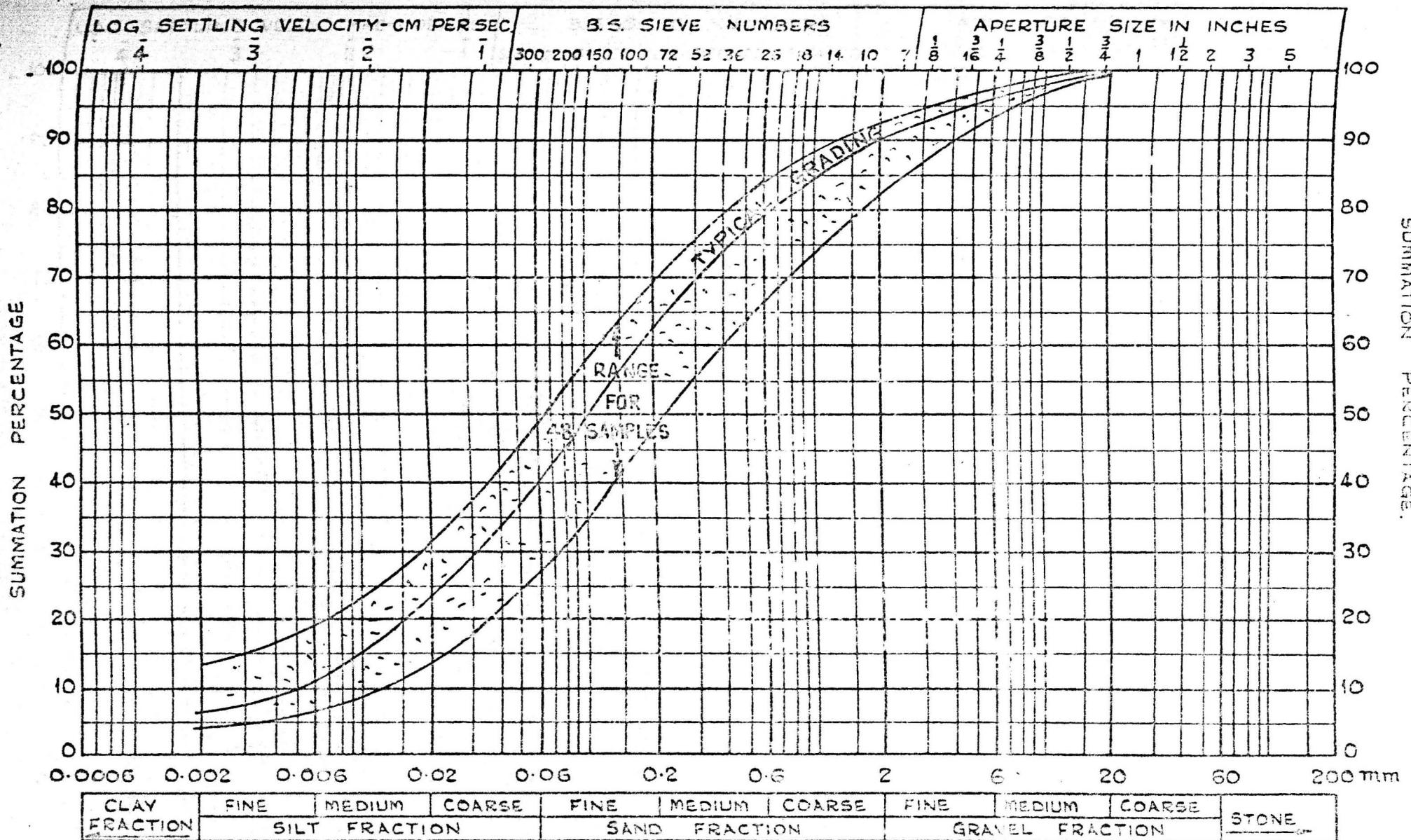
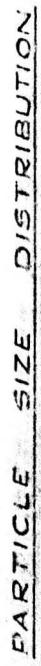


FIG. 5.97

GRADINGS FOR AKERSVATN DAM TILL (17)



## SEMI-LOG PLOT

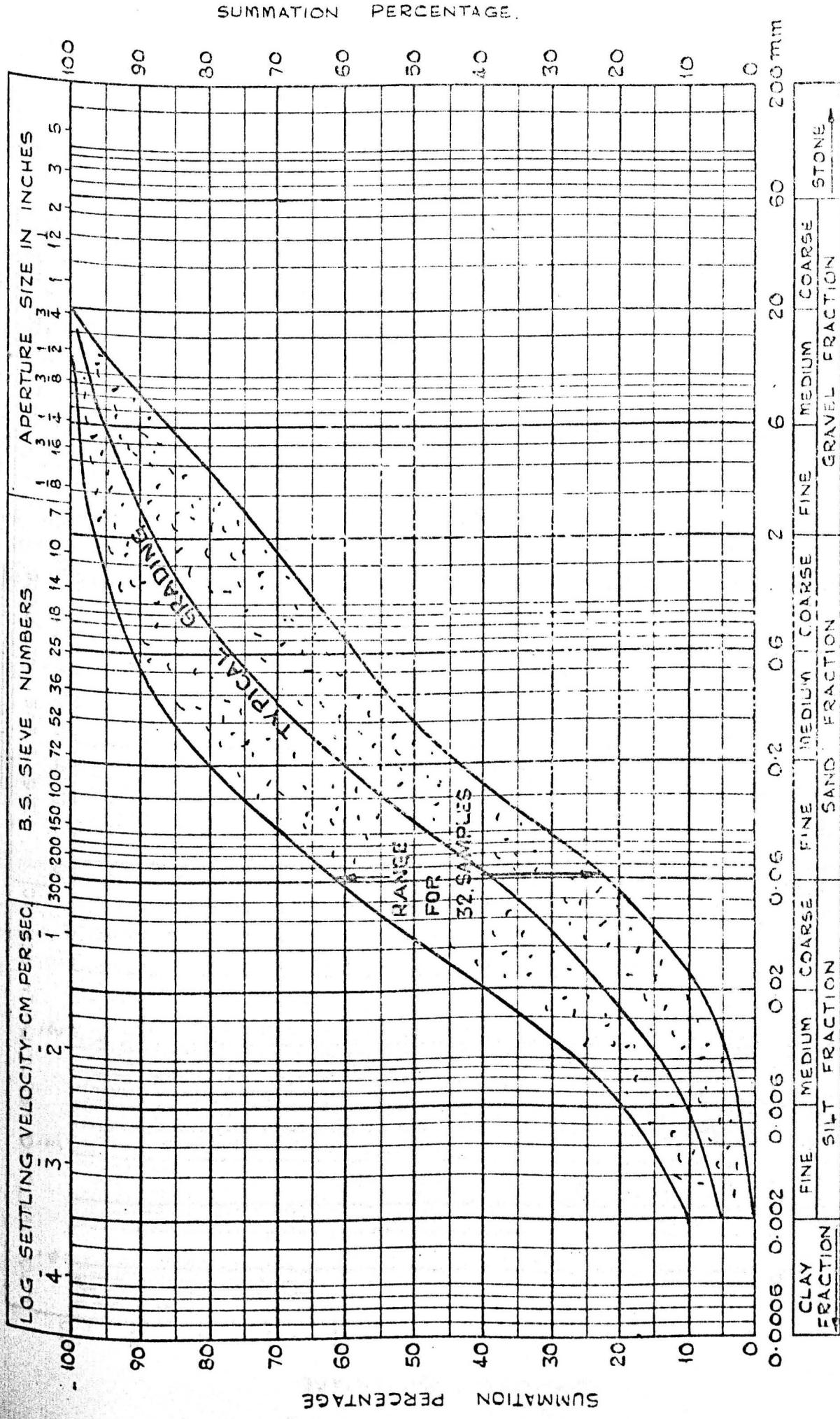


FIG. 5.98 GRADINGS FOR CALVATION (SPRATTUS NIGRA) DRIED TILIA (18)

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

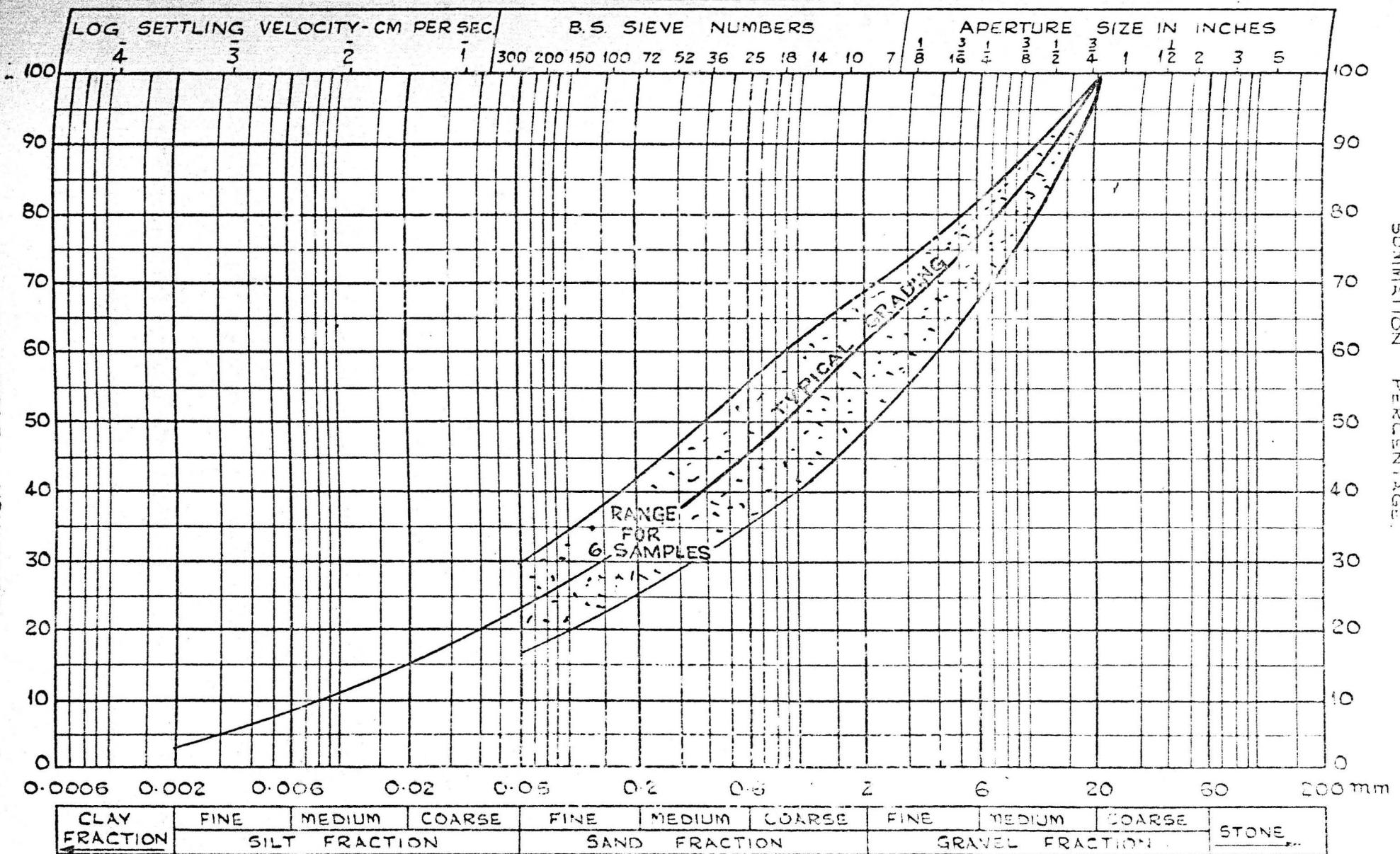


FIG. 5.99 GRADINGS FOR VASSLIVATN DAM TILL (22)

PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT

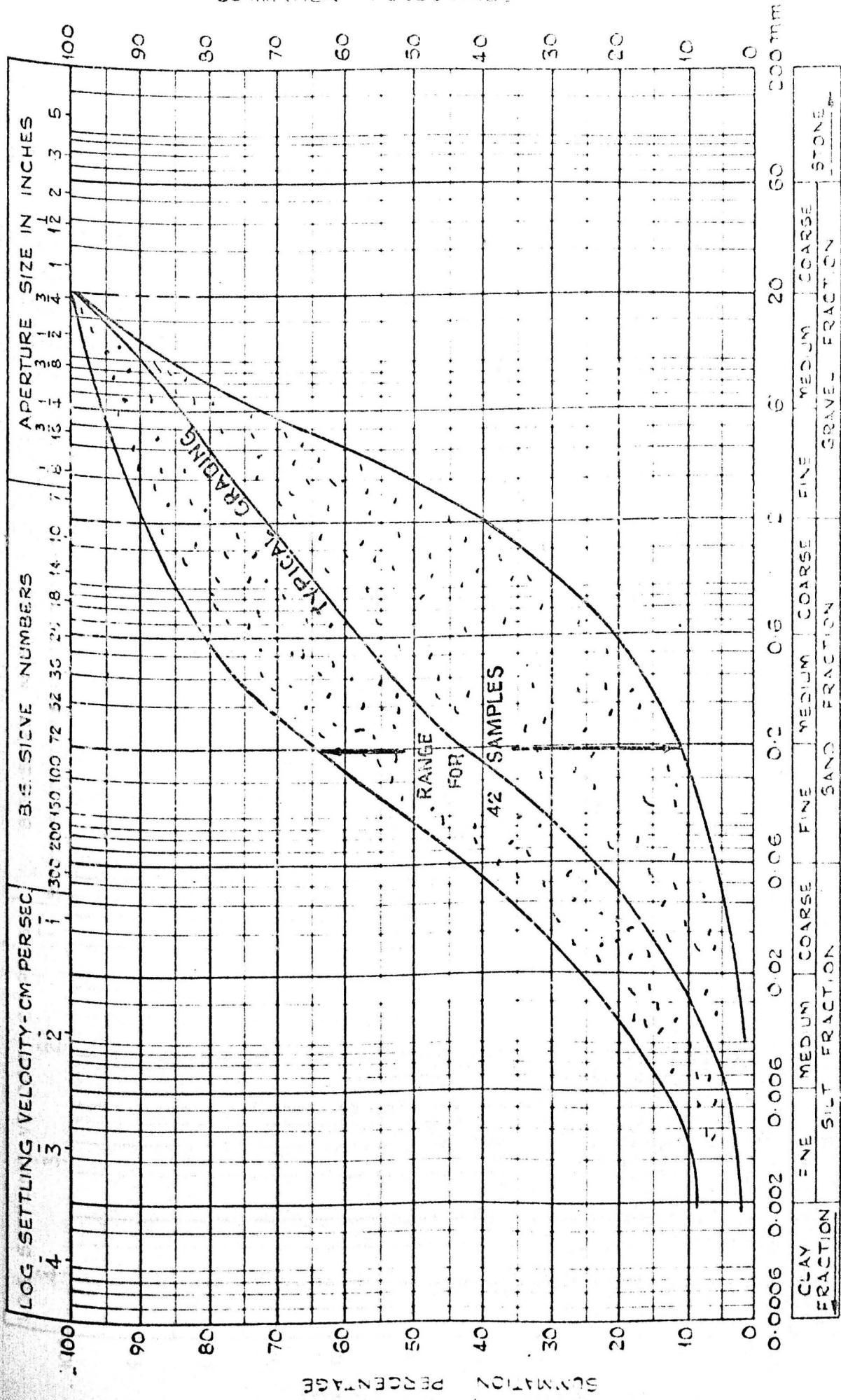


FIG. 5.100 GRADINGS FOR FULLER'S TERRAIN (27)

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

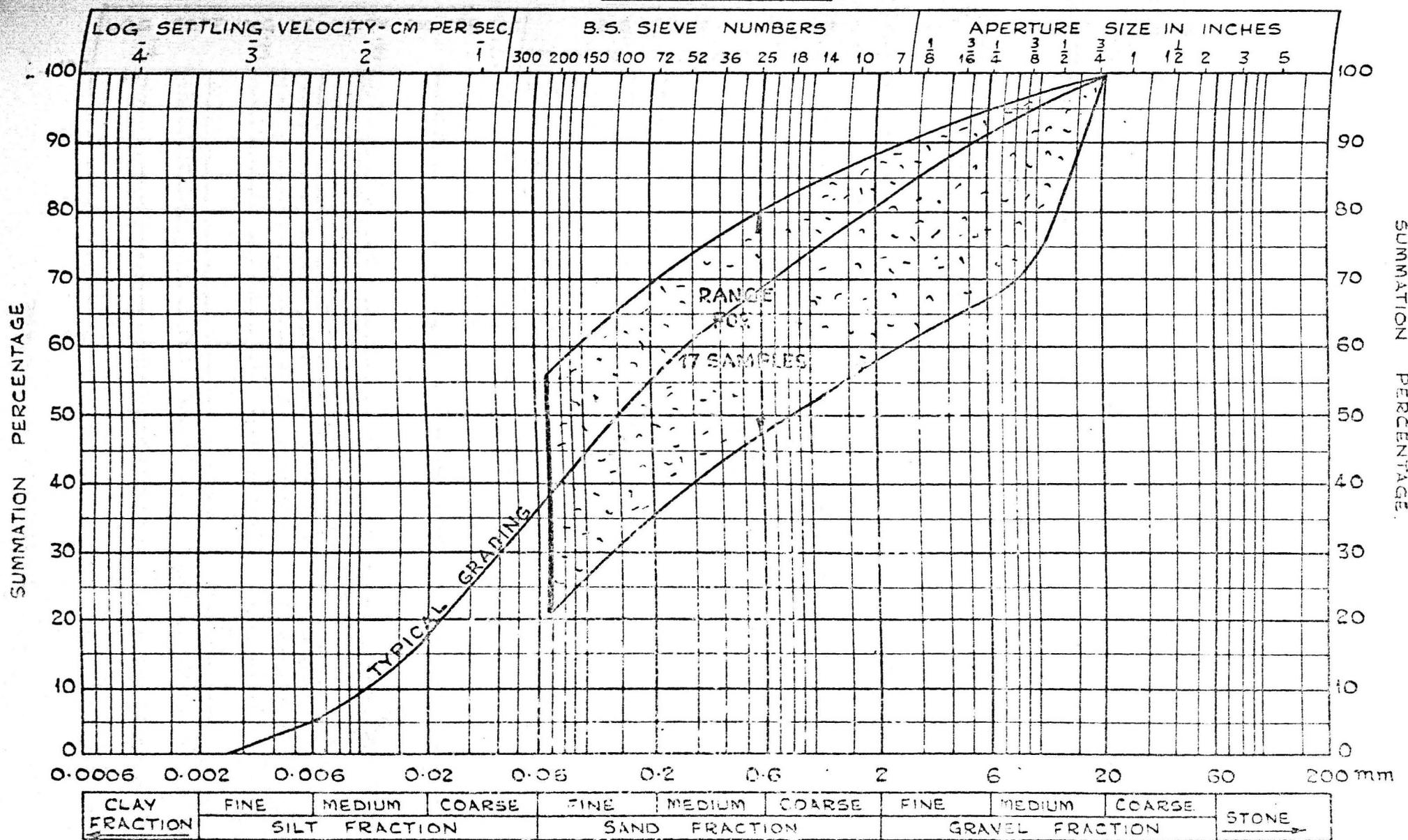


FIG. 5.101. GRADINGS FOR MANN DLA DAM TILL (28)

PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT

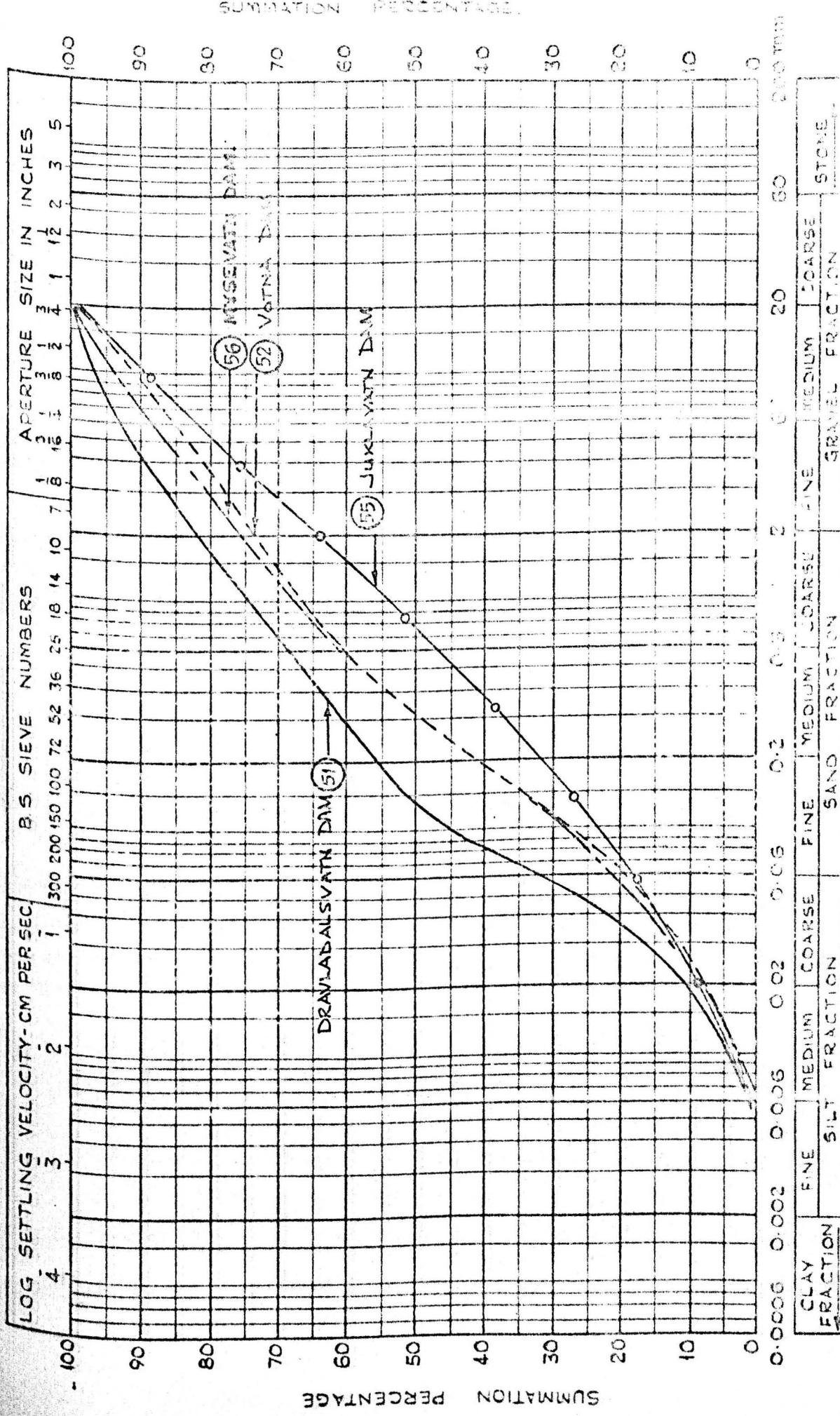


FIG. 5.102 GRADINGS FOR VARIOUS NORWEGIAN DAMS.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

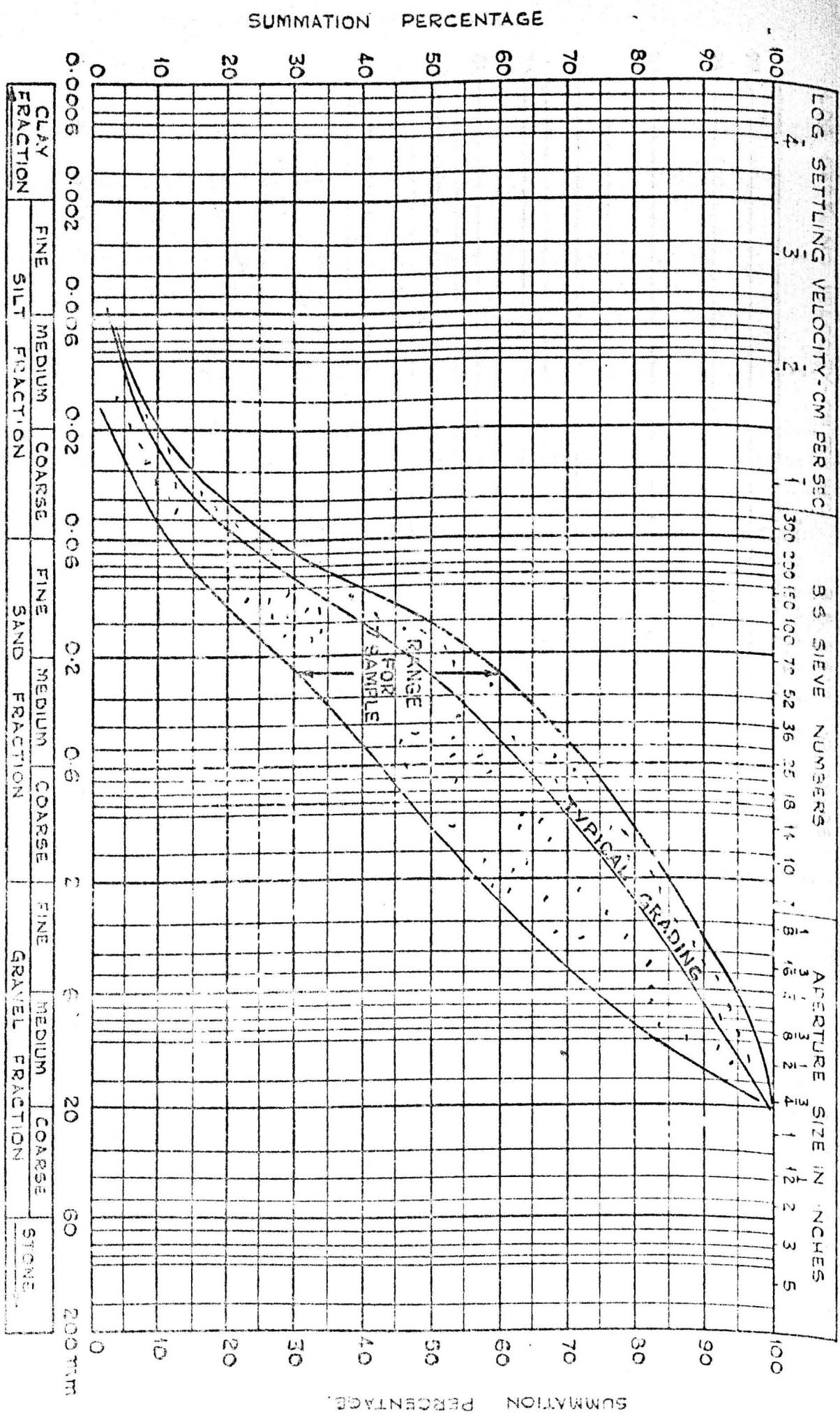


FIG. 5.103 GRADING FOR STALSVATN DAM. (Cx-1) TILL

PARTICLE SIZE DISTRIBUTION

LOG PROBABILITY PLOT.

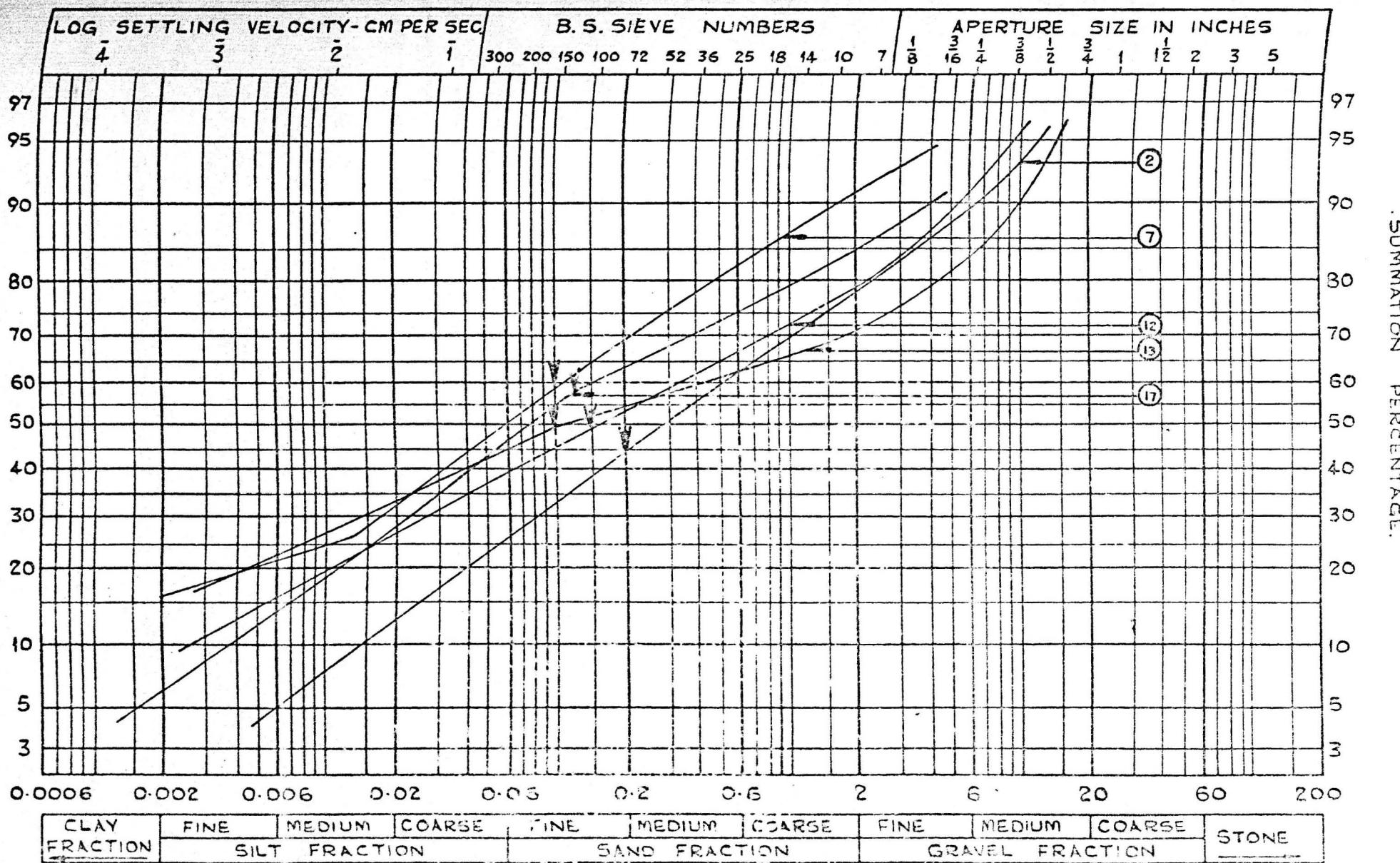


FIG. 5.104 LOG PROBABILITY PLOT OF NORWEGIAN DAM TILLS (3 - 17)

PARTICLE SIZE DISTRIBUTION

LOG PROBABILITY PLOT

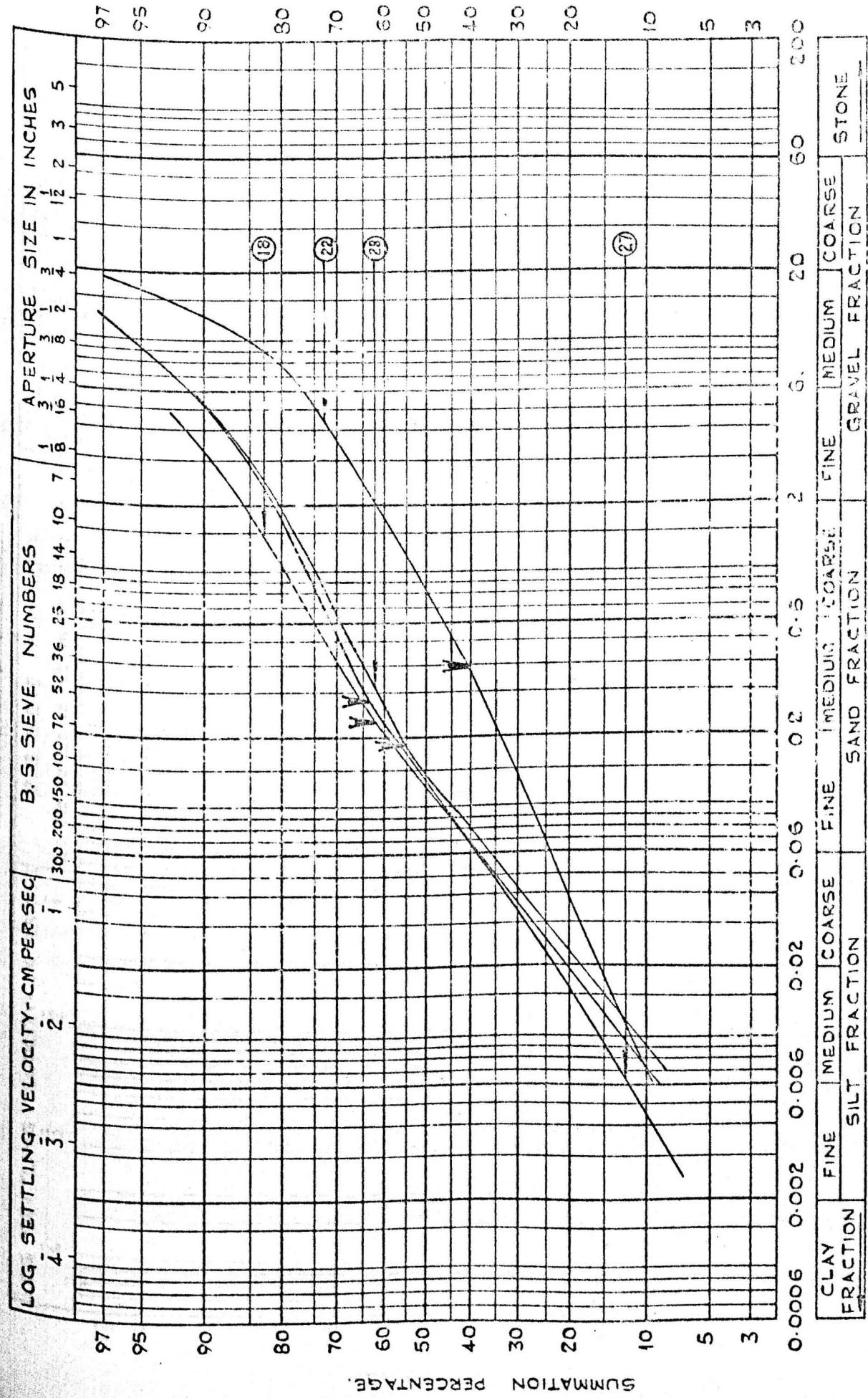


FIG. 5.105 LOG PROBABILITY PLOT FOR NARROWED DAM TILLS (18 - 27)

PARTICLE SIZE DISTRIBUTION

LOG PROBABILITY PLOT.

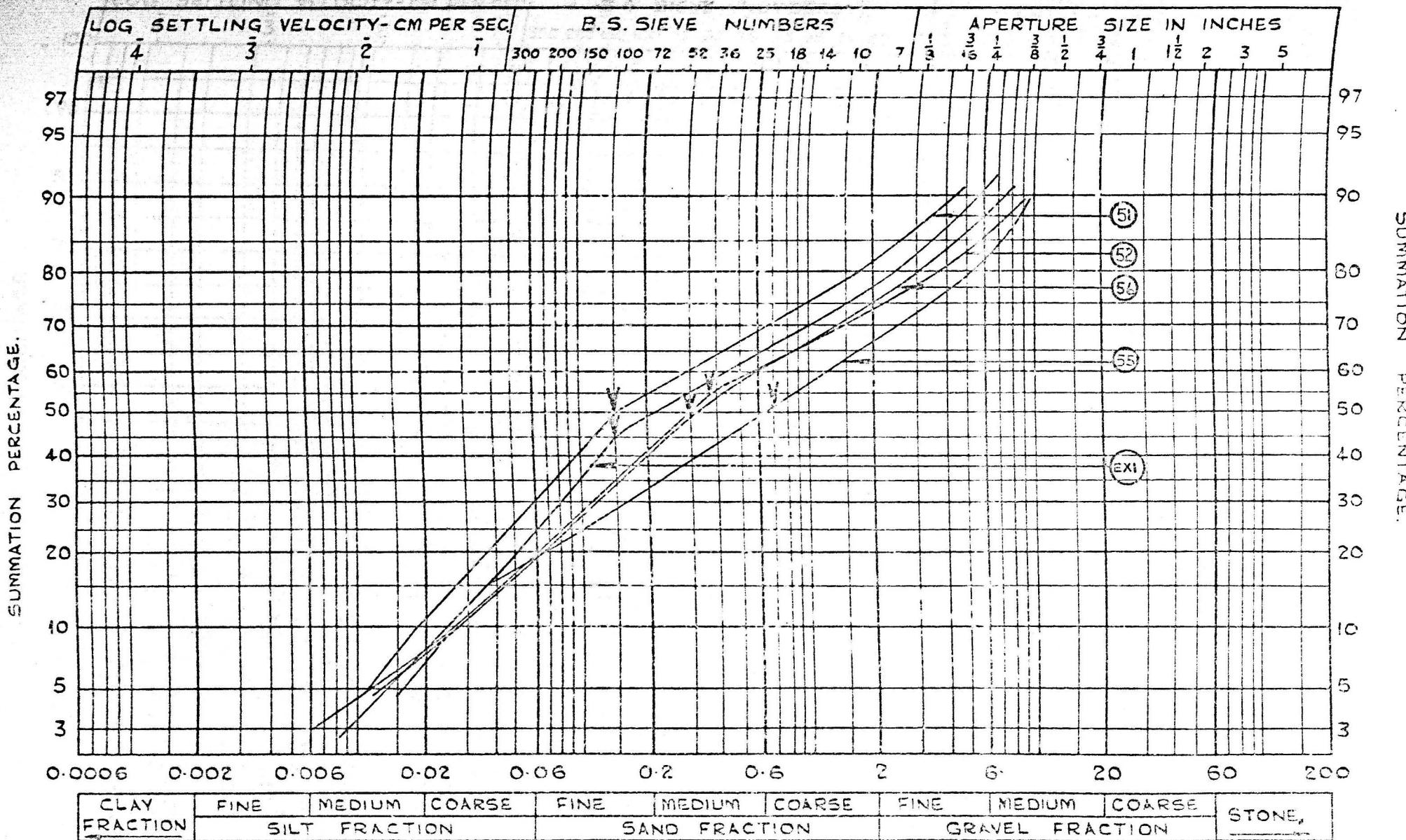


FIG. 5.106

LOG PROBABILITY PLOTS FOR NORVEGIAN DAM TILLS (51 - EXI).

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

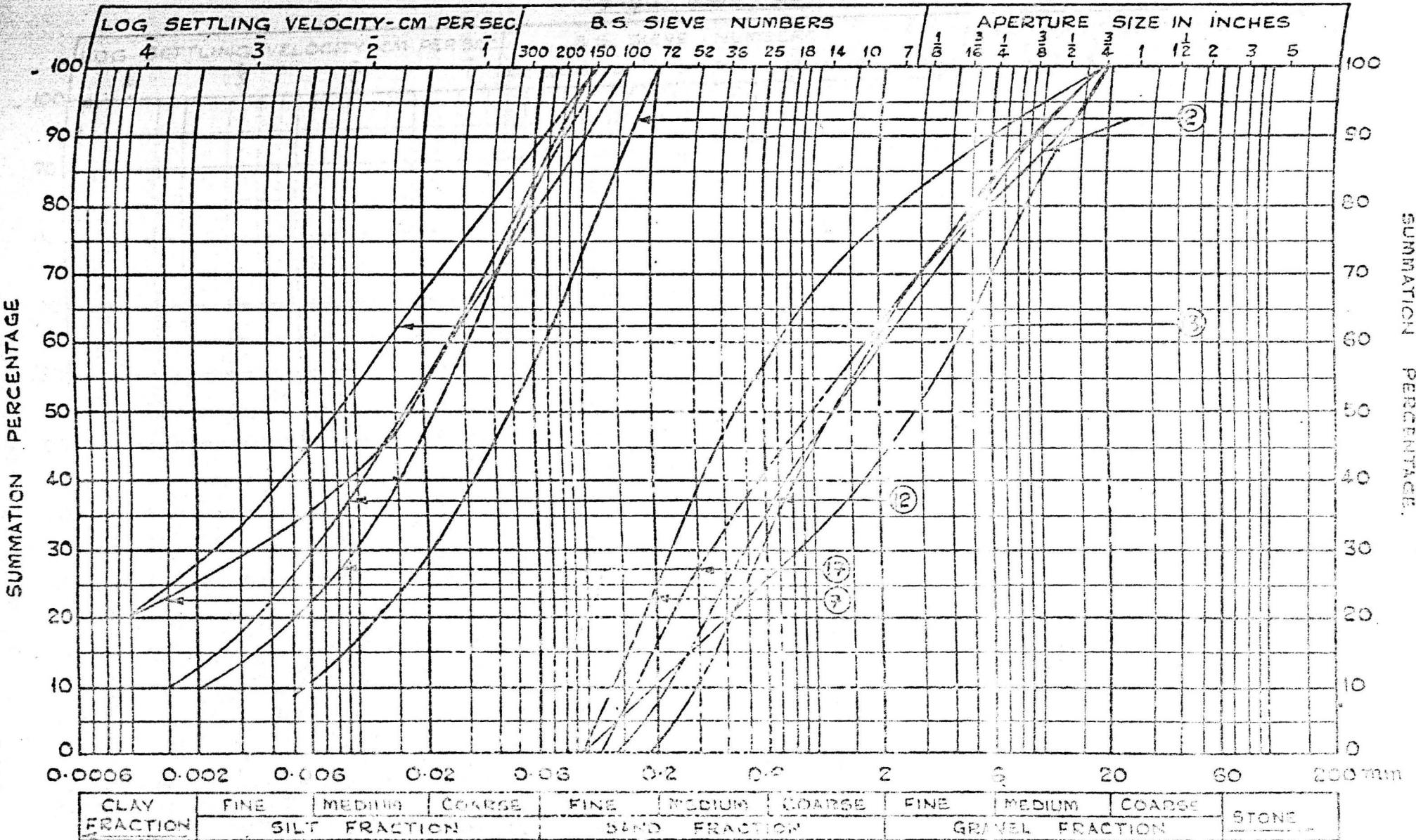


FIG. E-107. SIZE FRACTIONS FOR NORWICHIAN DANI TILLS (1-17)

PARTICLE SIZE DISTRIBUTION

SEMI - LOG PLOT

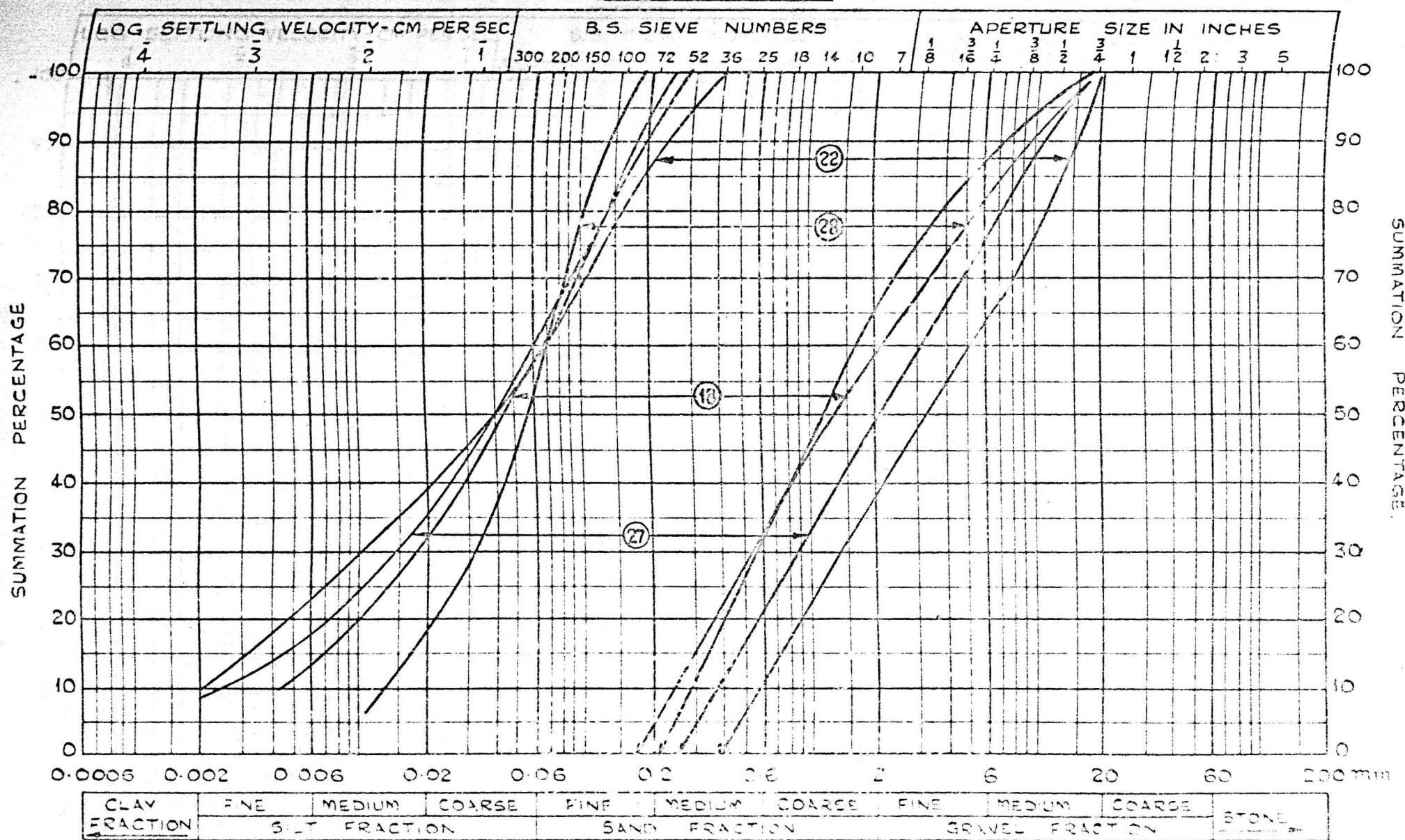


FIG. 5-108 SIZE FRACTIONS FOR NORWEGIAN DAM TILLS (18-27).

PARTICLE SIZE DISTRIBUTION  
SEMI - LOG PLOT

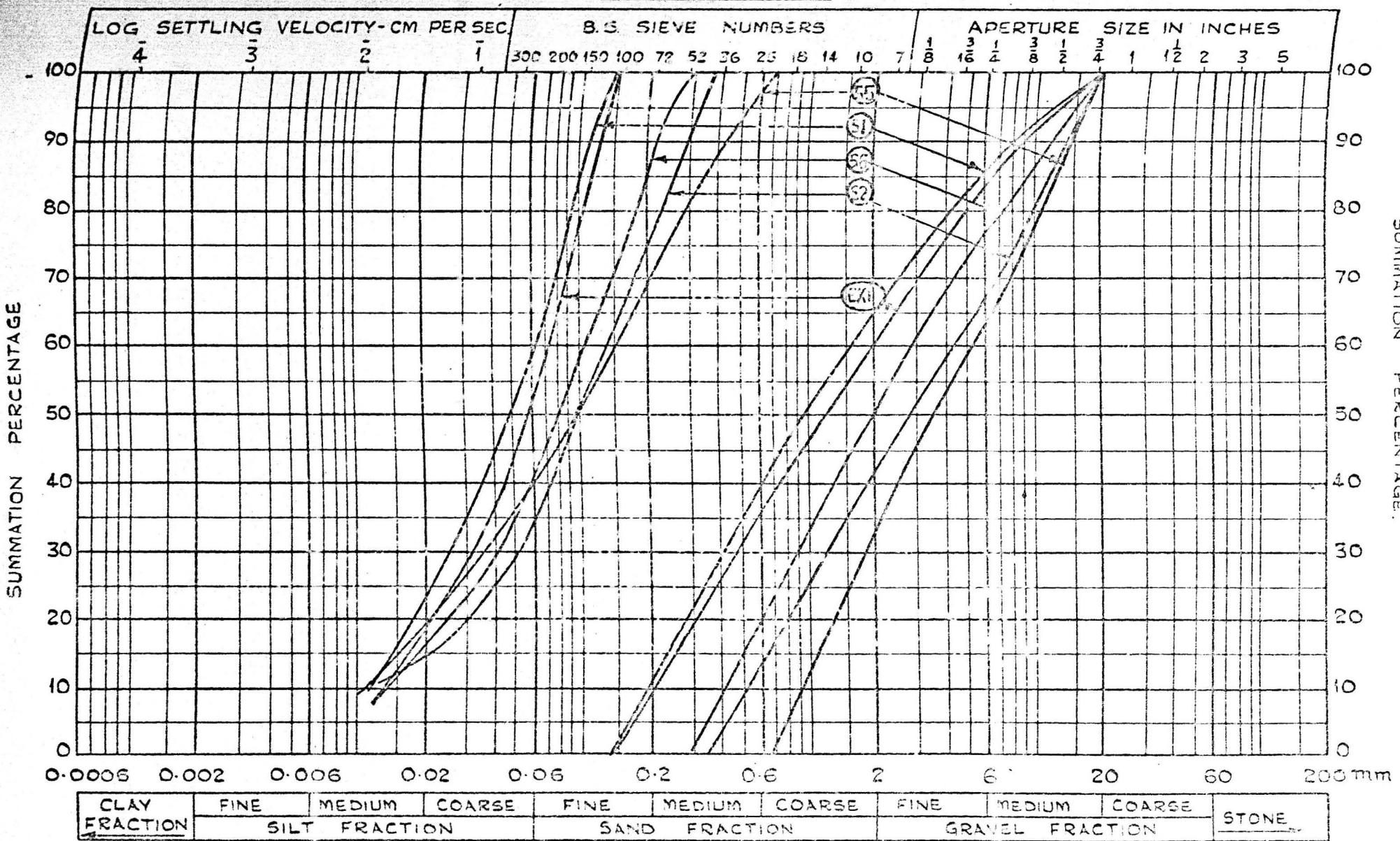


FIG. 5.109 SIZE FRACTIONS FOR NORWEGIAN DAM TILLS (SI-EXI)

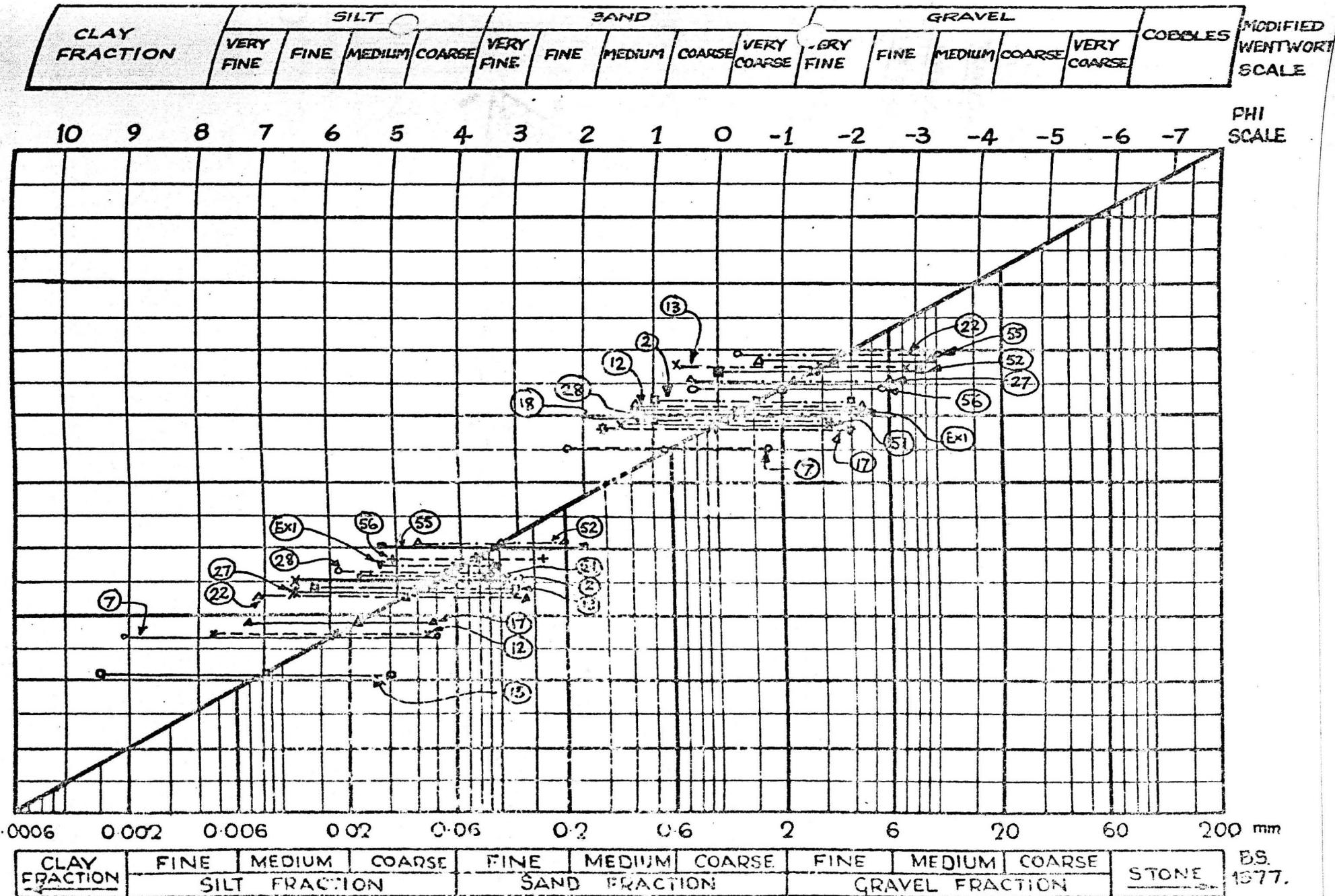
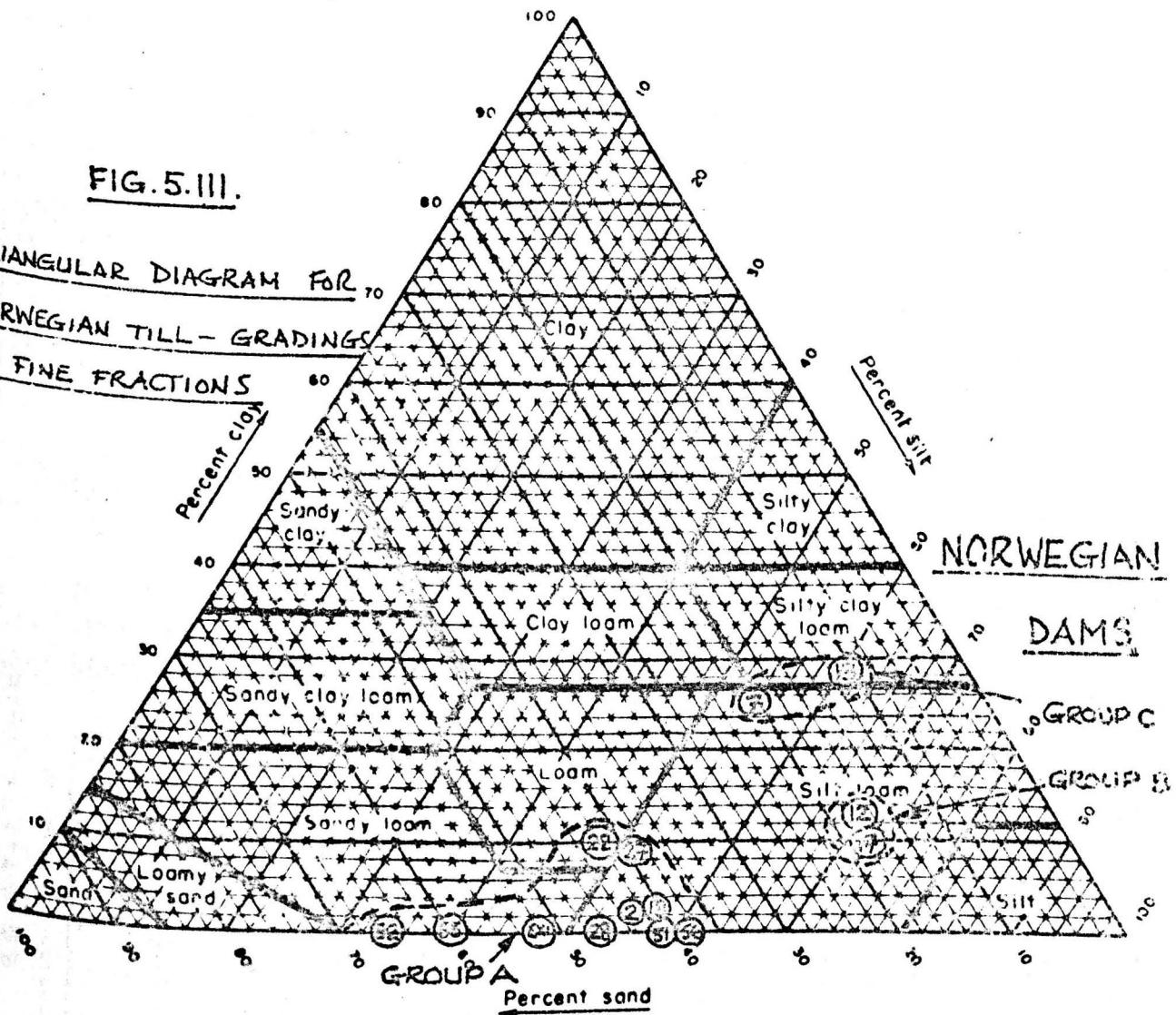


FIG. 5.10. TEXTURAL CLASSIFICATION BASED ON  $Q_s$ ,  $M_s$ ,  $Q_a$  FOR NORWEGIAN DAMS.

FIG. 5.111.

TRIANGULAR DIAGRAM FOR  
NORWEGIAN TILL - GRADINGS  
OF FINE FRACTIONS



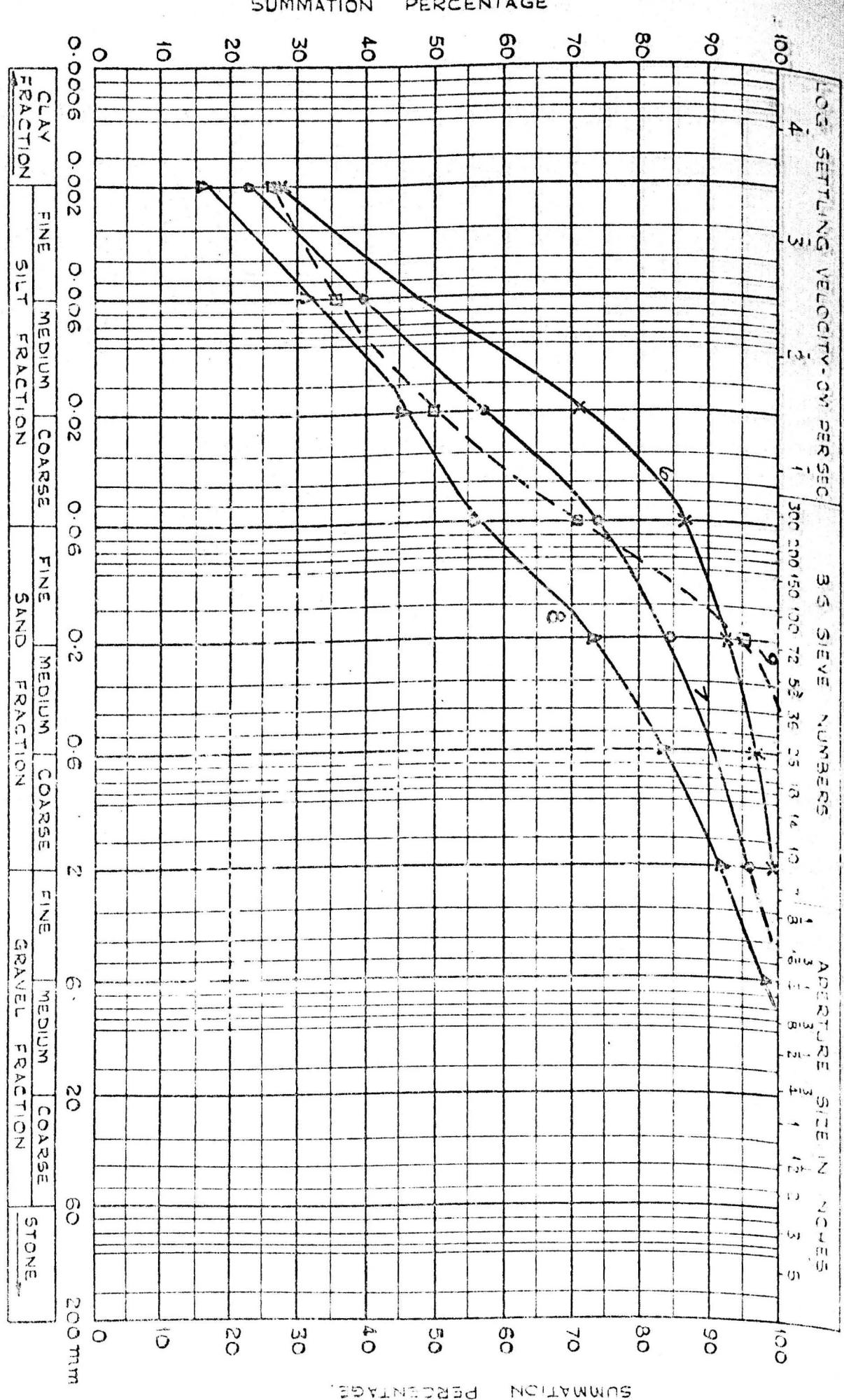


FIG. 5.112. GRADINGS FOR CANADIAN DUST TILLS (6-9)

PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT

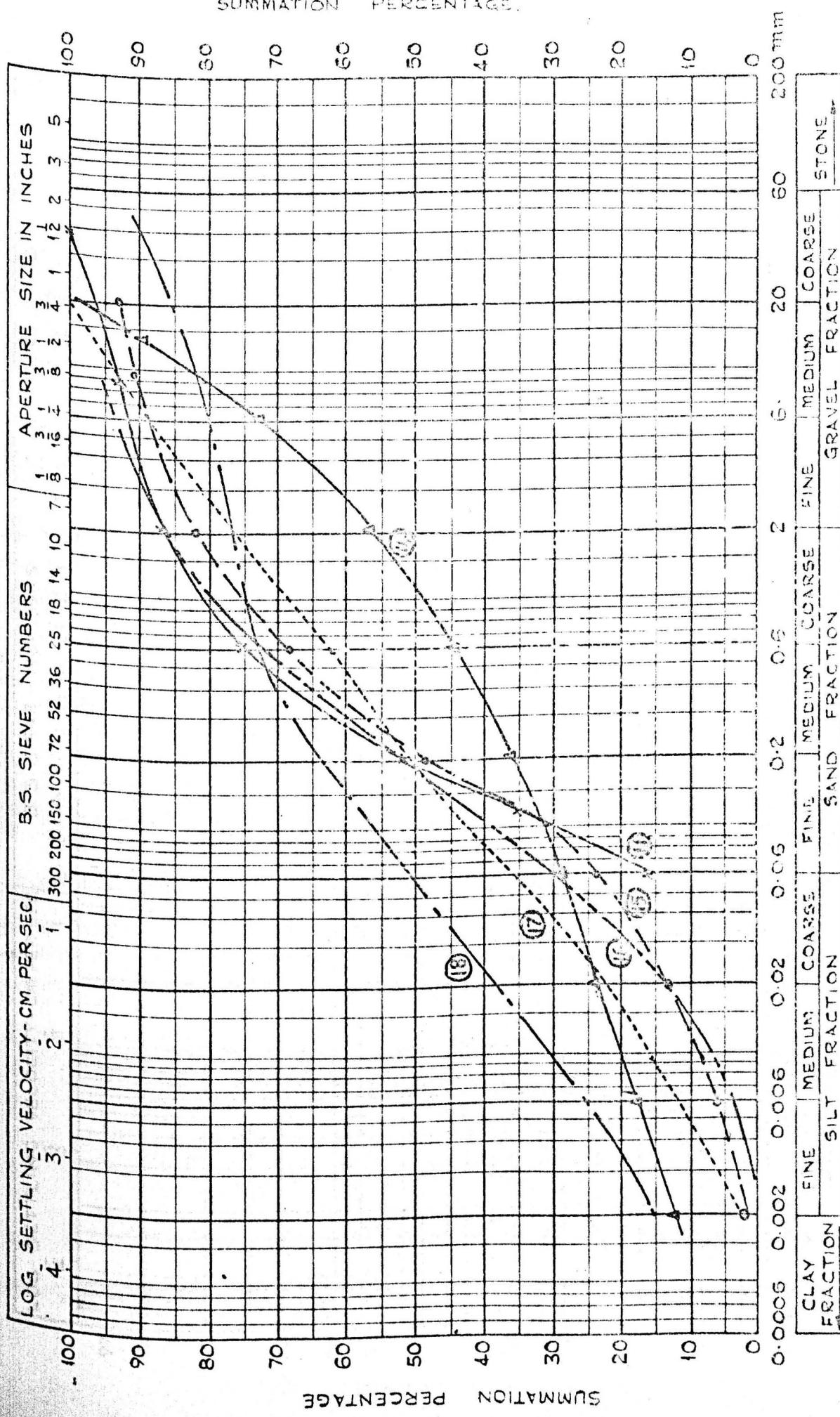


FIG. 5.113. GRADINGS FOR CANADIAN DAM THILLS (H-18).

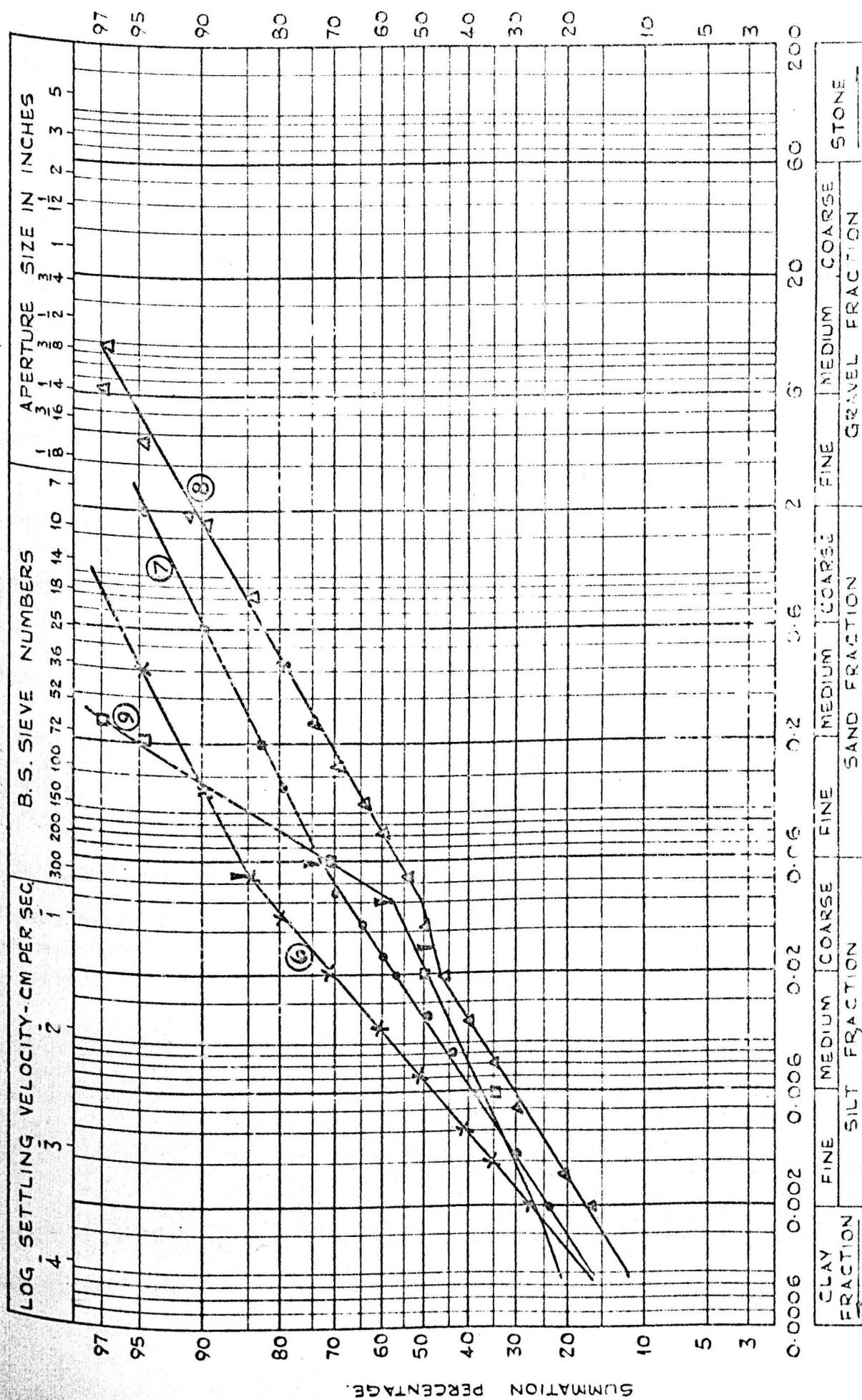
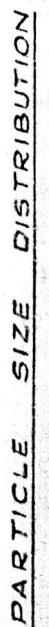


FIG. 5114. LOG PROBABILITY PLOT FOR CHLAMYDIA BACTERIUM (S- $\Omega$ ).

PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT

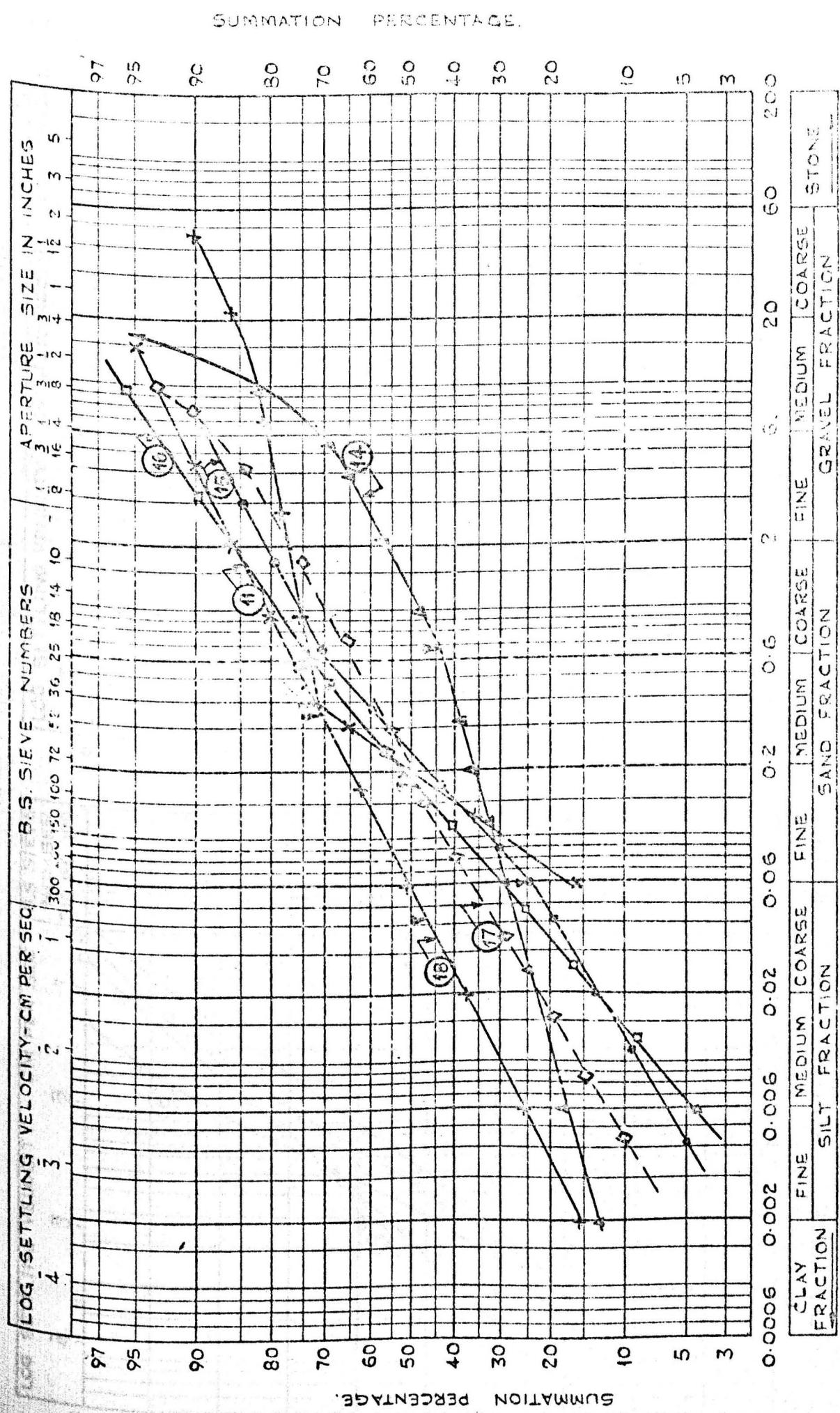


FIG. 5.115 Log Probability Plot for Canadian Dam Mills (11-18).

PARTICLE SIZE DISTRIBUTION  
SEMI - LOG PLOT

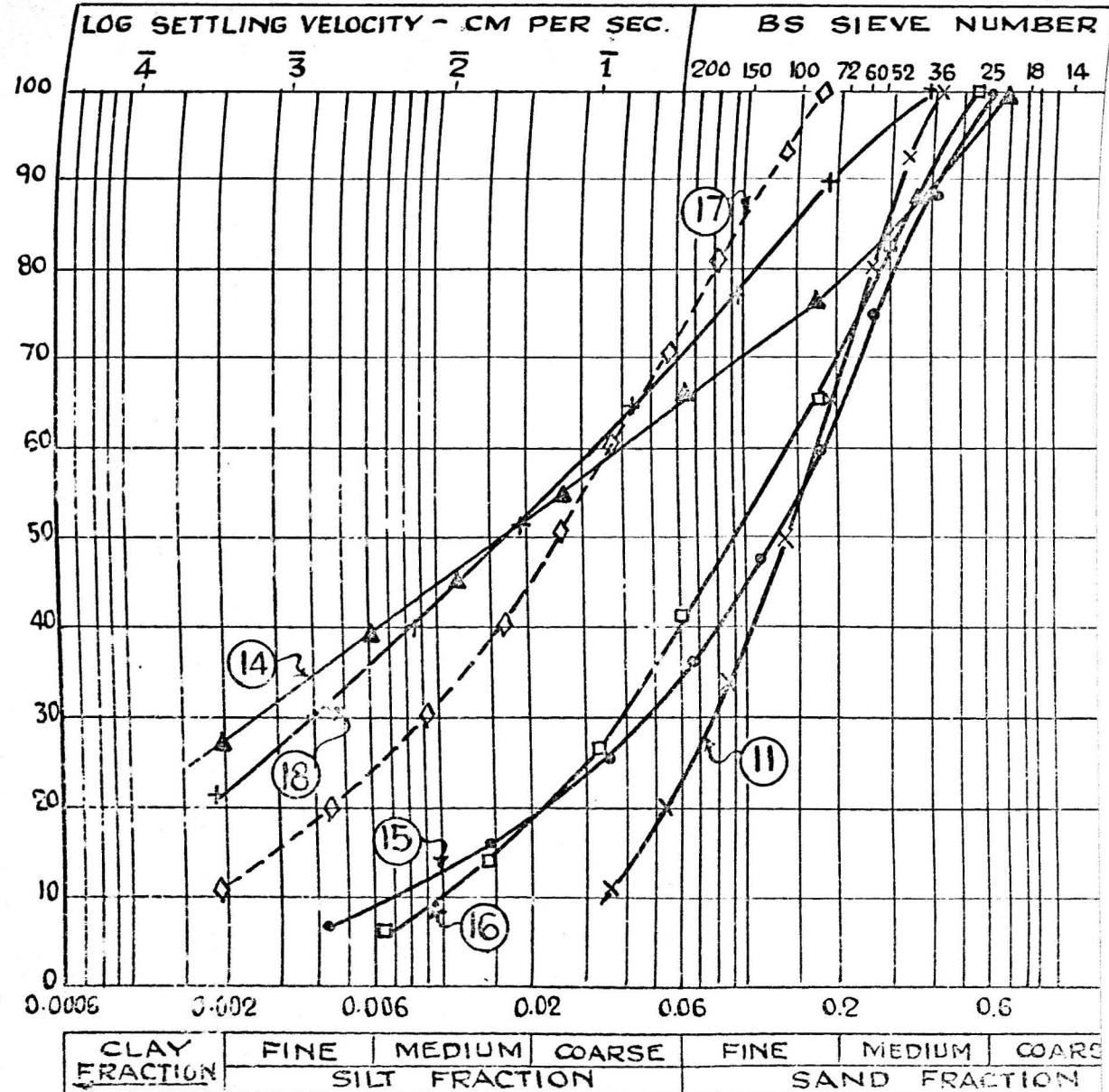
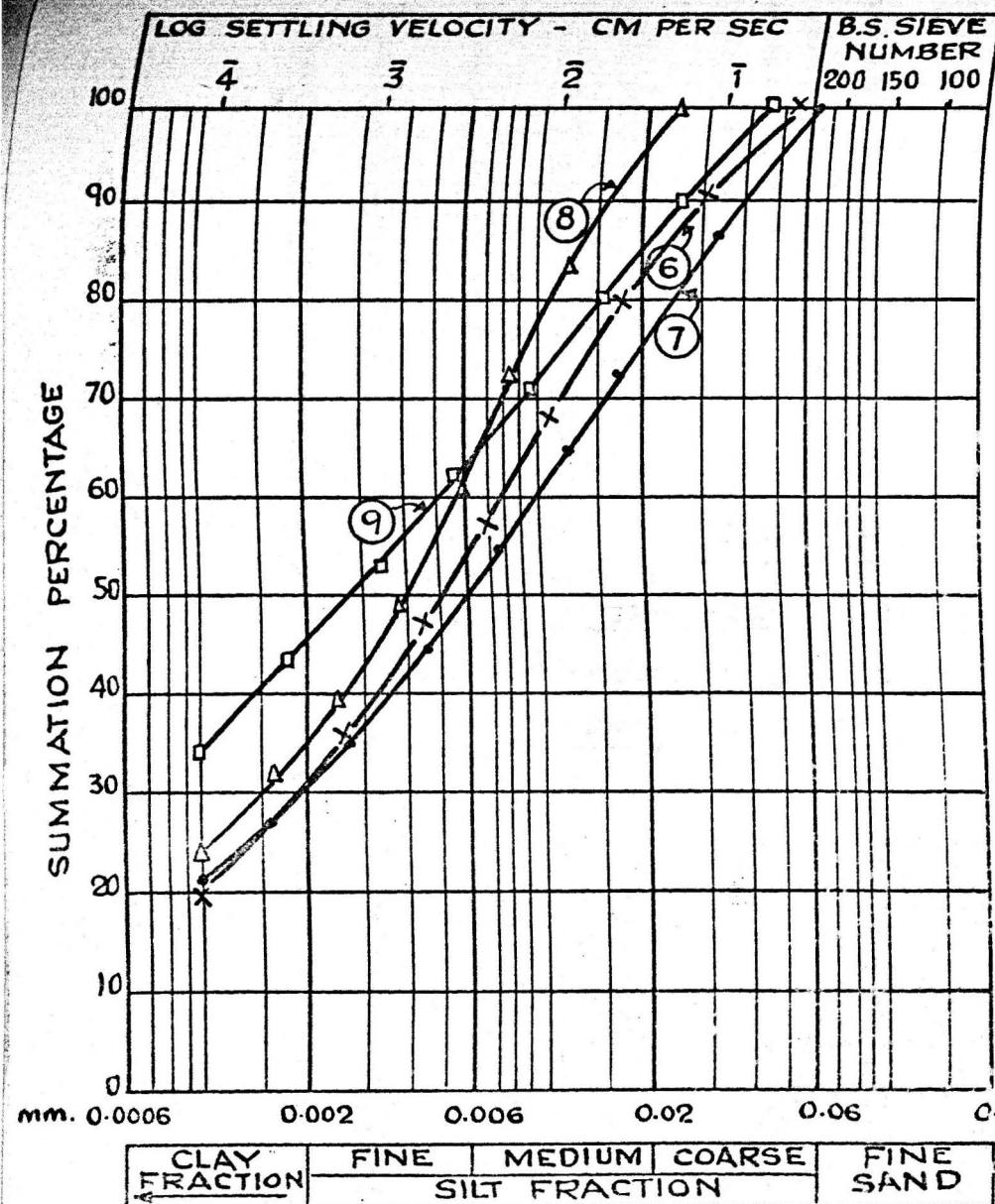


FIG. 5.116. FINE FRACTIONS OF CANADIAN DAM TILLS.

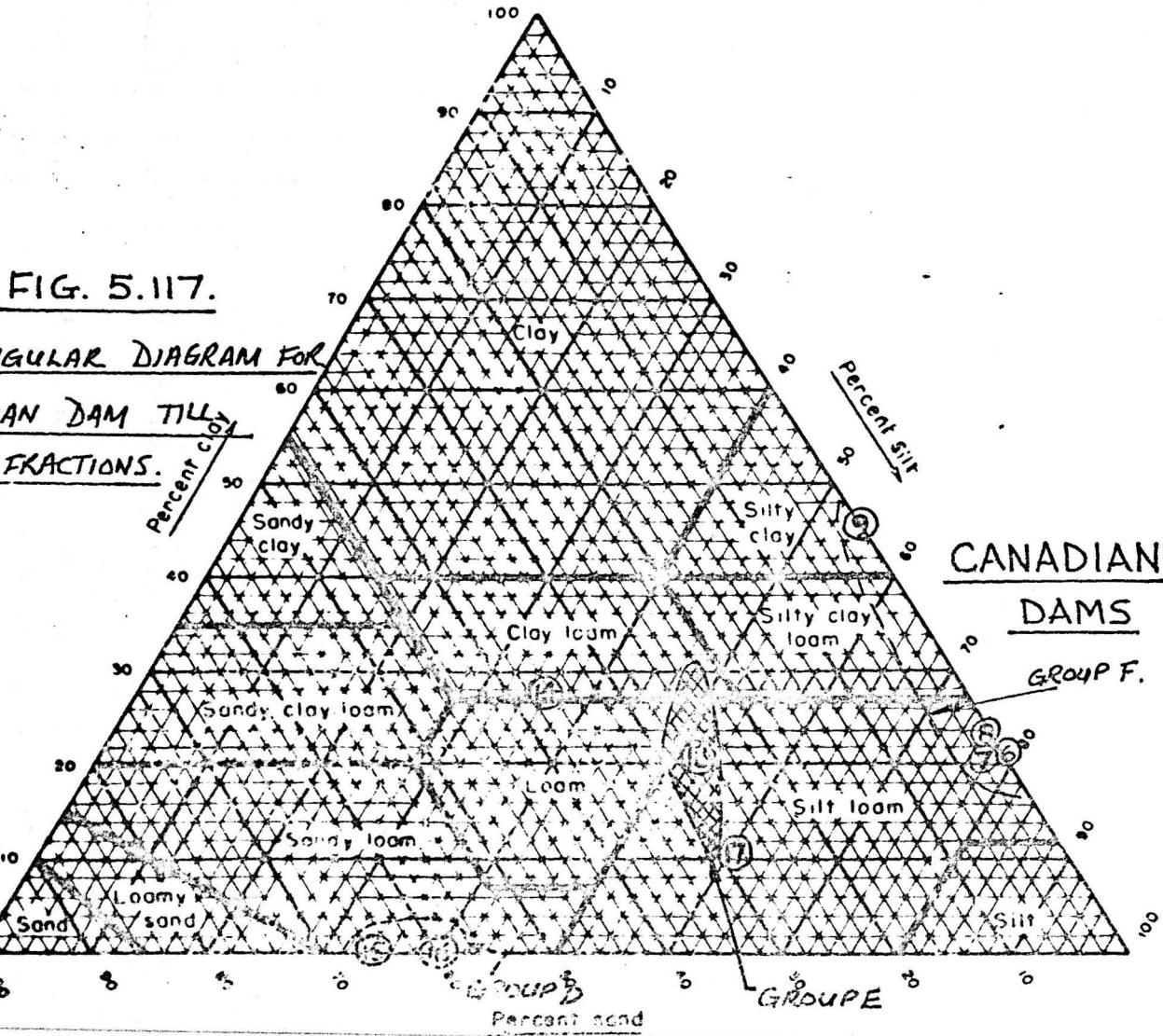


FIG. 5.117.

TRIANGULAR DIAGRAM FOR  
CANADIAN DAM TILL  
FINE FRACTIONS.

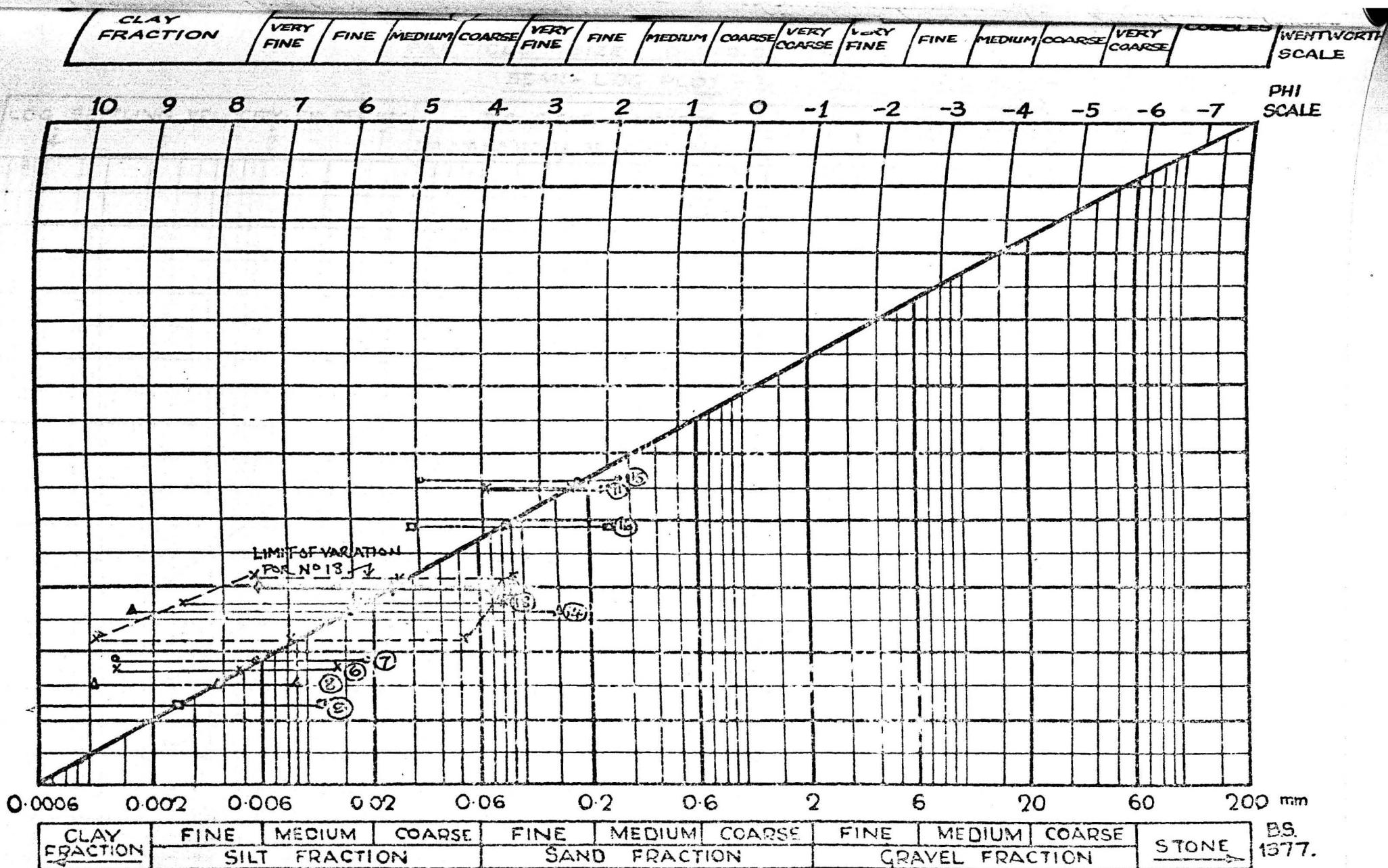


FIG.5.118 TEXTURAL CLASSIFICATION BASED ON  $Q_1, M_d, Q_3$  FOR CANADIAN DAM TILLS.

PARTICLE SIZE DISTRIBUTION

SEMI - LOG PLOT

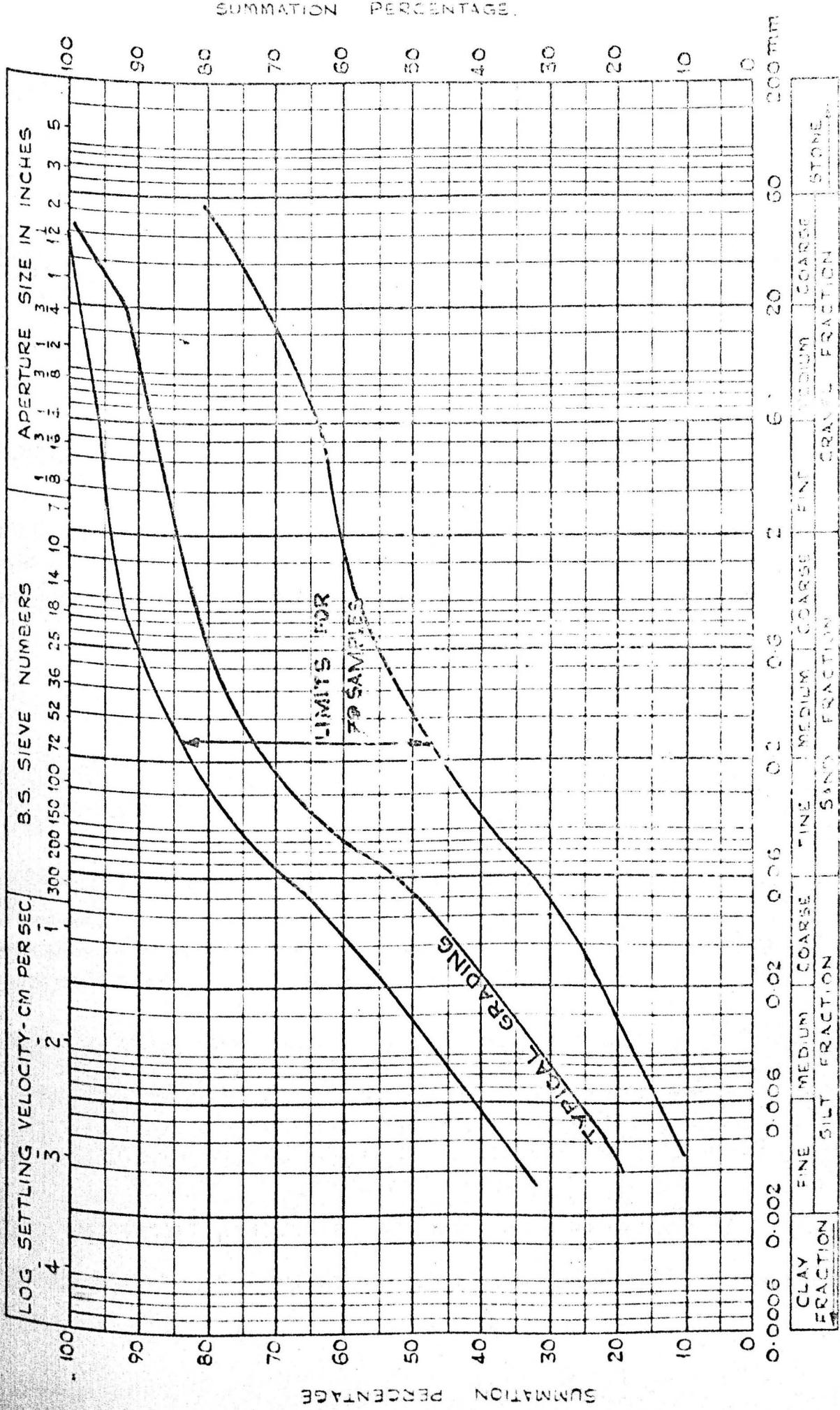


FIG 5.19. GRADINGS FOR SAND AND CANADA (18).

PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT

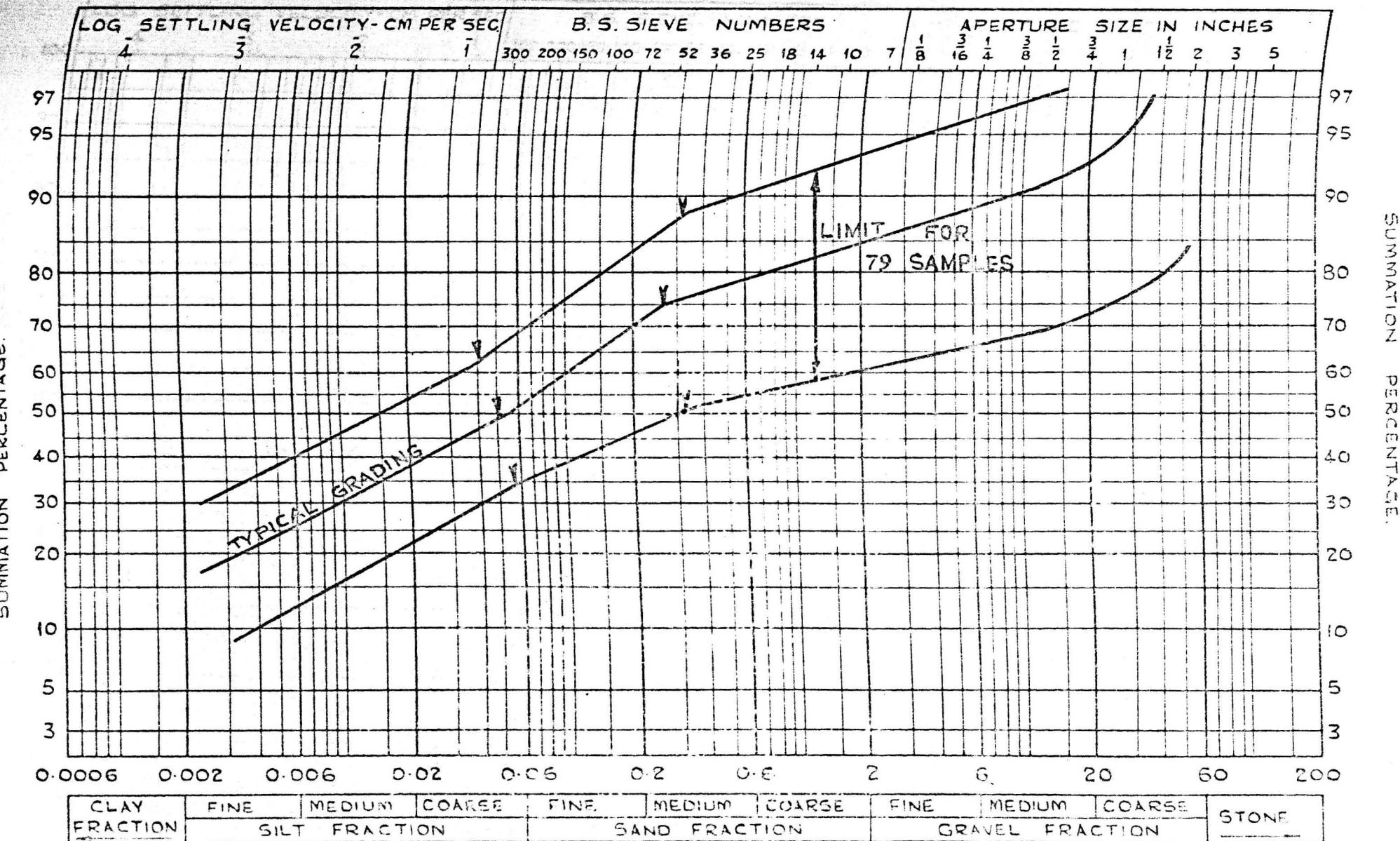


FIG 5.120. LOG PROBABILITY FOR SHIND DAM, CANADA (18)

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

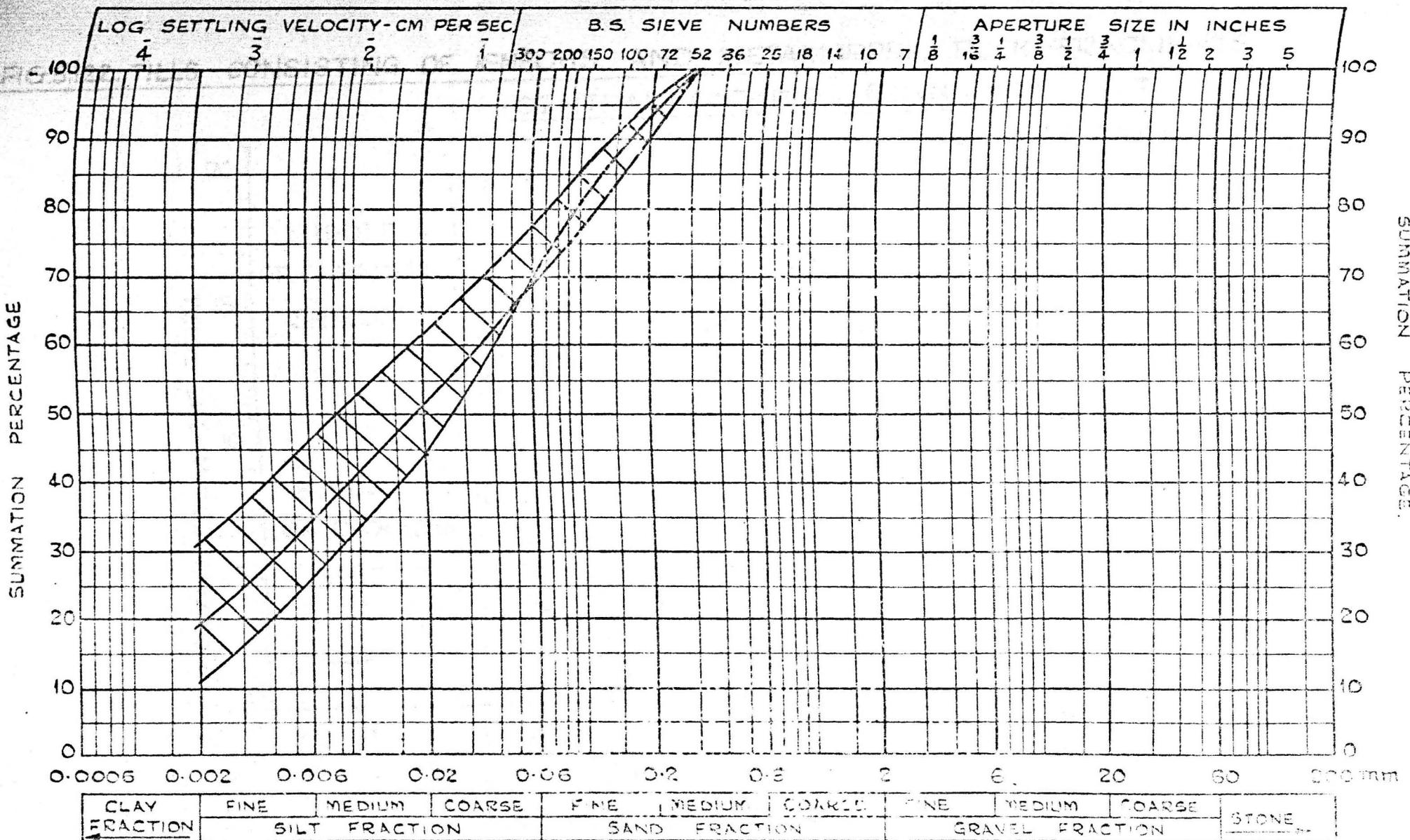
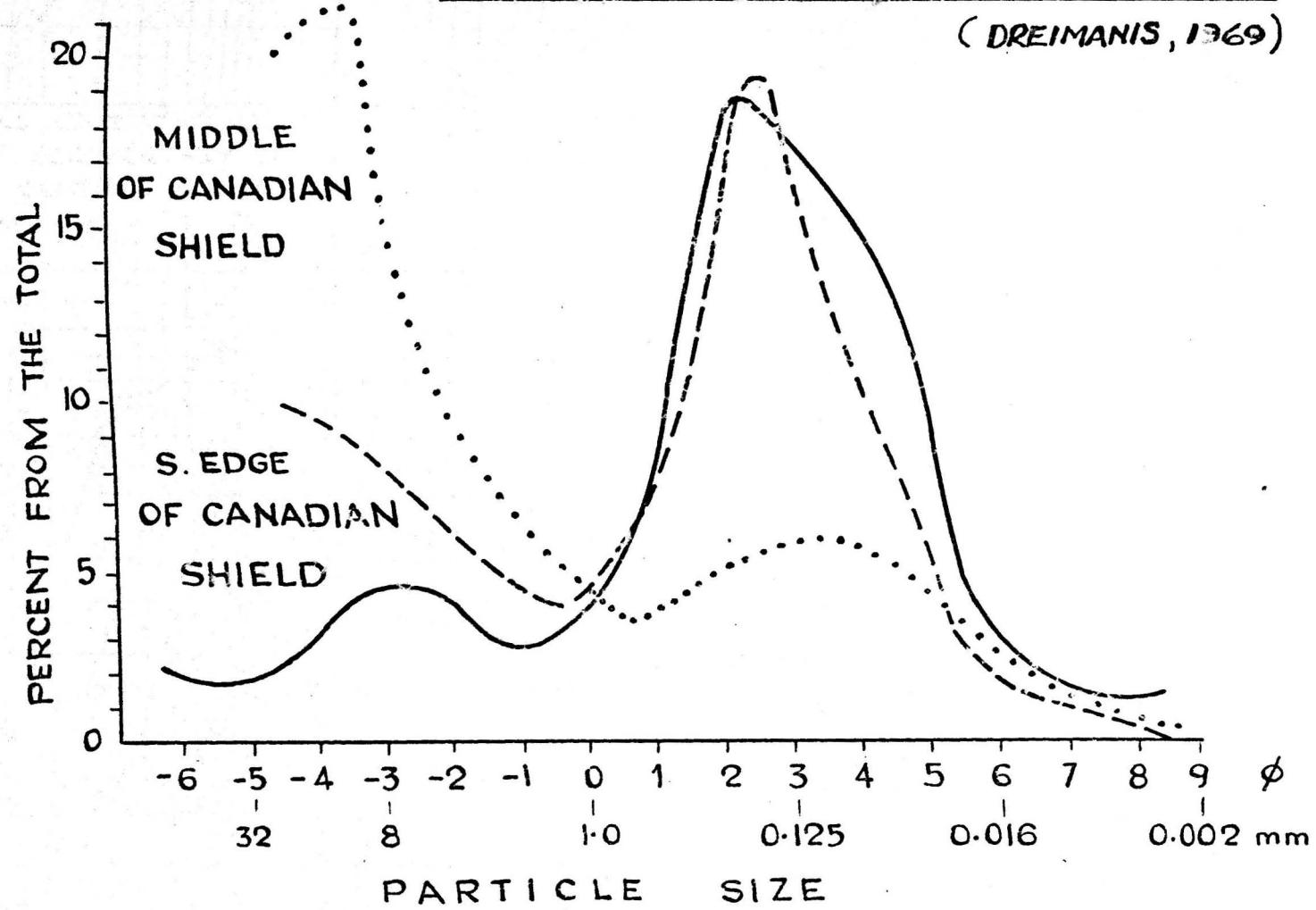


FIG 5.121. FINE FRACTIONS OF SILAND DAM TILL CANADA.

FIG.5.122. TILLS CONSISTING OF IGNEOUS AND METAMORPHIC ROCK FRAGMENTS

CENTRAL ONTARIO - FREQUENCY PLOT.

(DREIMANIS, 1969)



PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT

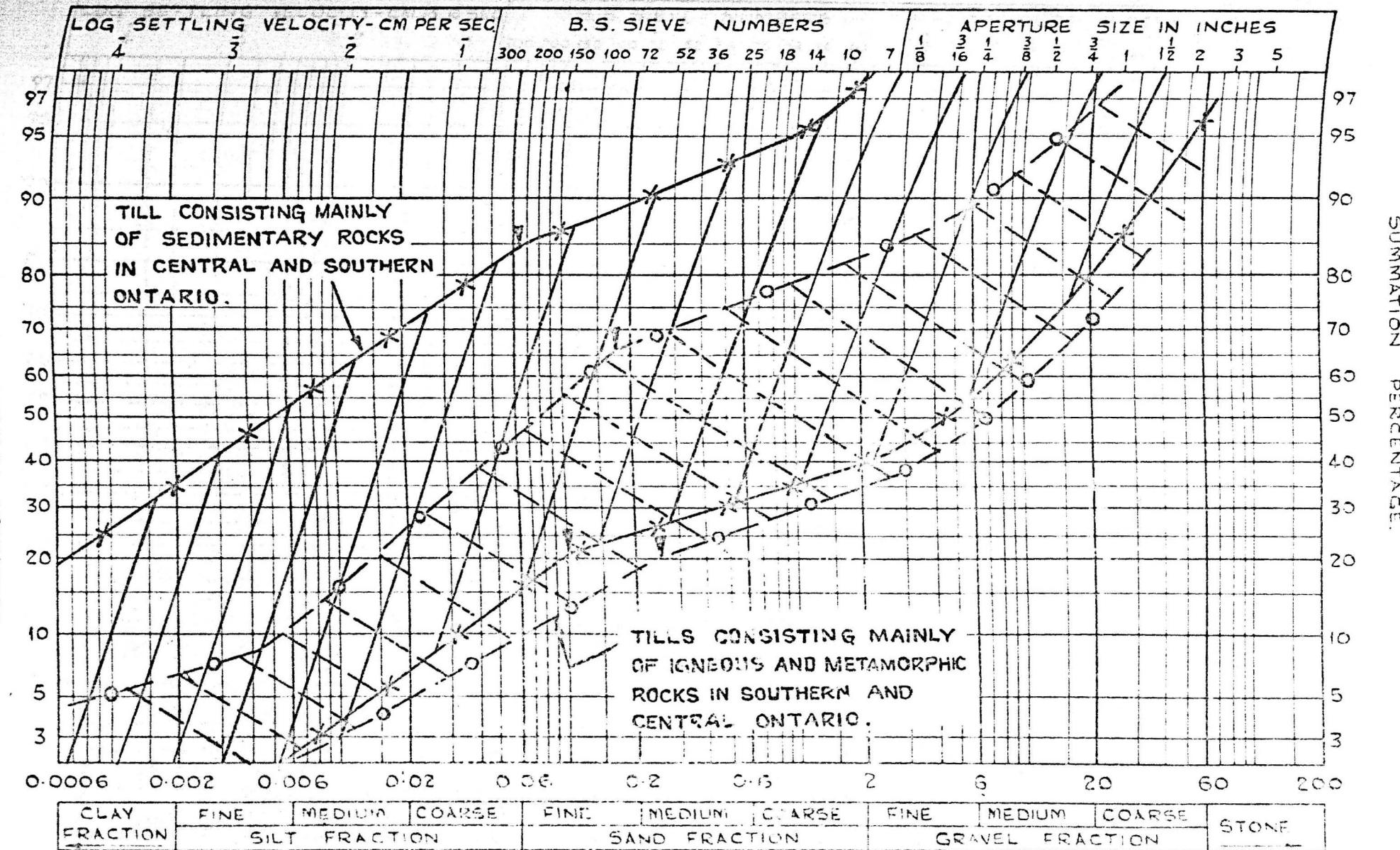


FIG. 5.123. LOG PROBABILITY PLOT OF SEDIMENTARY, IGNEOUS AND METAMORPHIC ONTARIO ROCK TILLS.

PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT

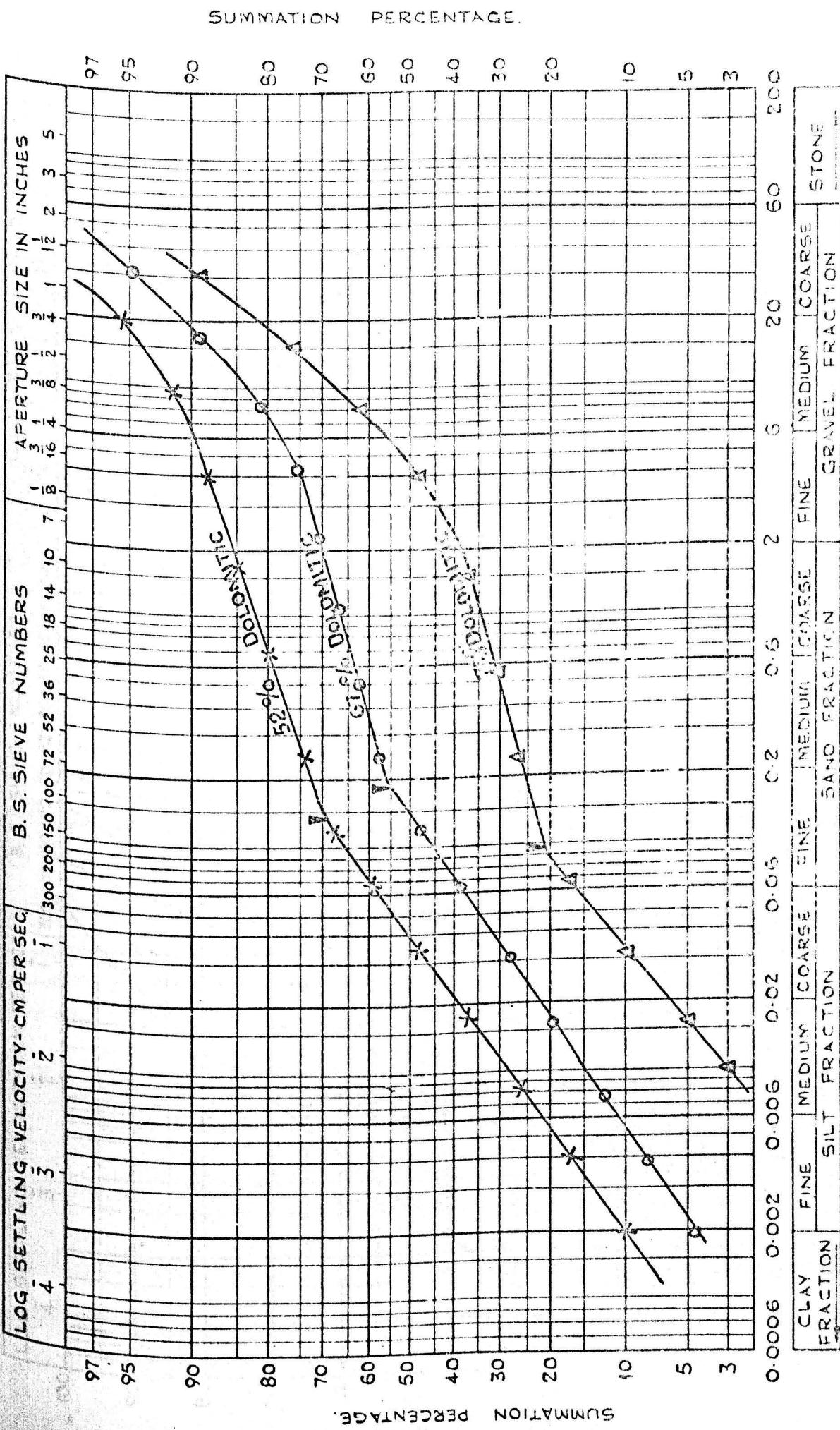


FIG. 124. LOG PROBABILITY PLOTS OF DOLOMITIC TILLS IN ONTARIO (AFTER DOLMAN, 1951).

PARTICLE SIZE DISTRIBUTION  
SEMI - LOG PLOT

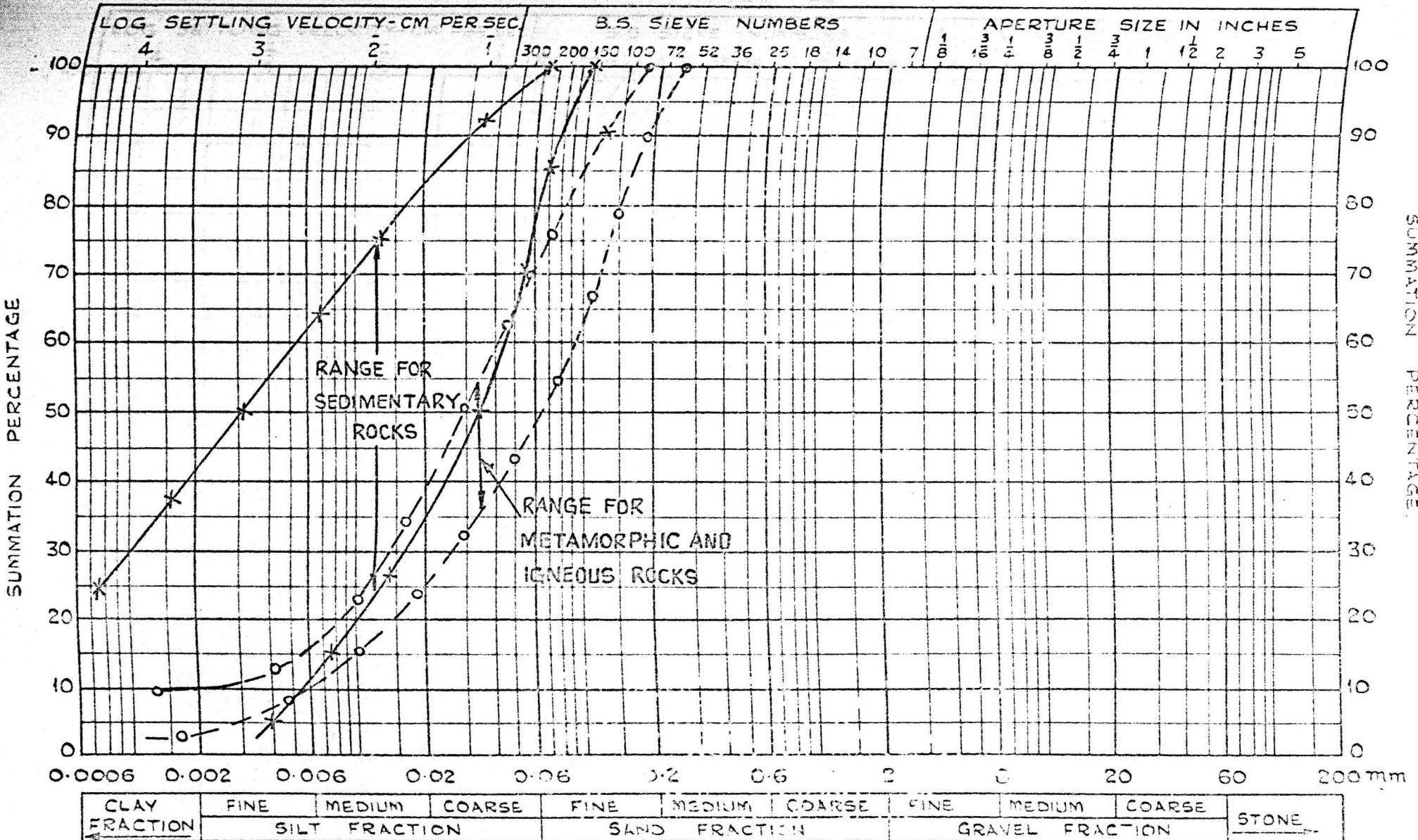


FIG. 5.125. GRADINGS FOR SEDIMENTARY, METAMORPHIC AND IGNEOUS Rock TILLS FROM ONTARIO

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

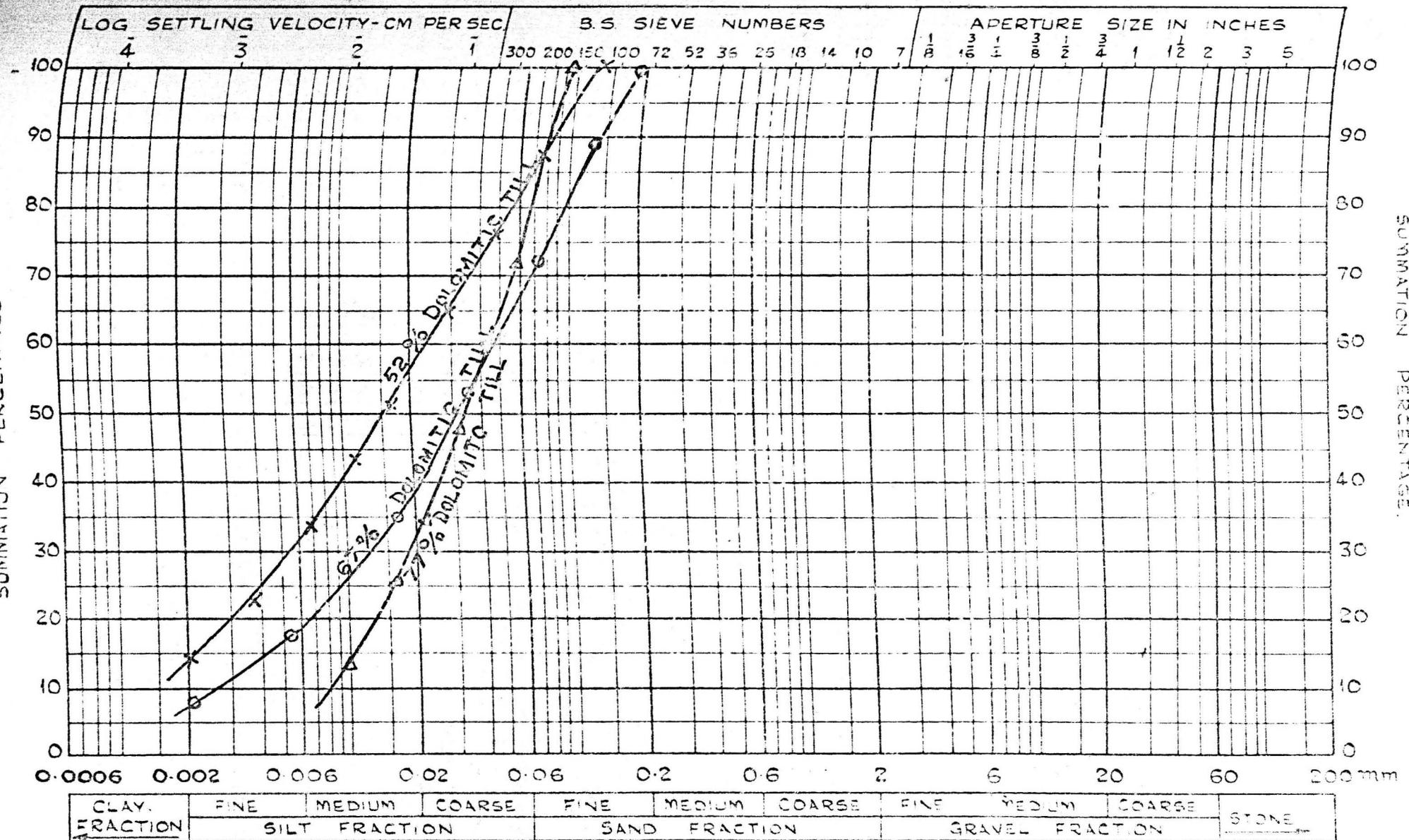
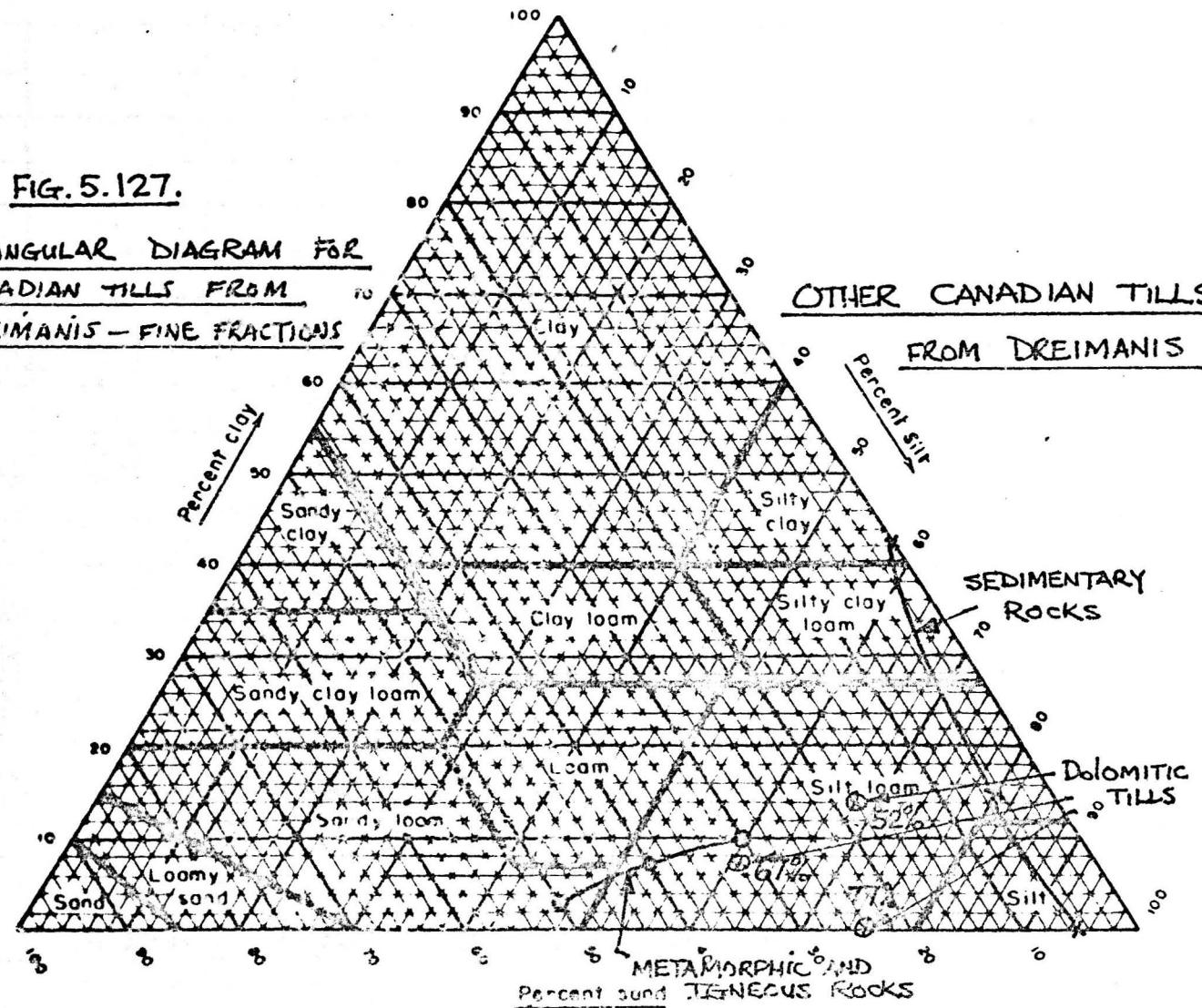


FIG. 5.126. GRADINGS FOR DOLOMITIC TILLS IN ONTARIO (after DREIMANIS, 1968).



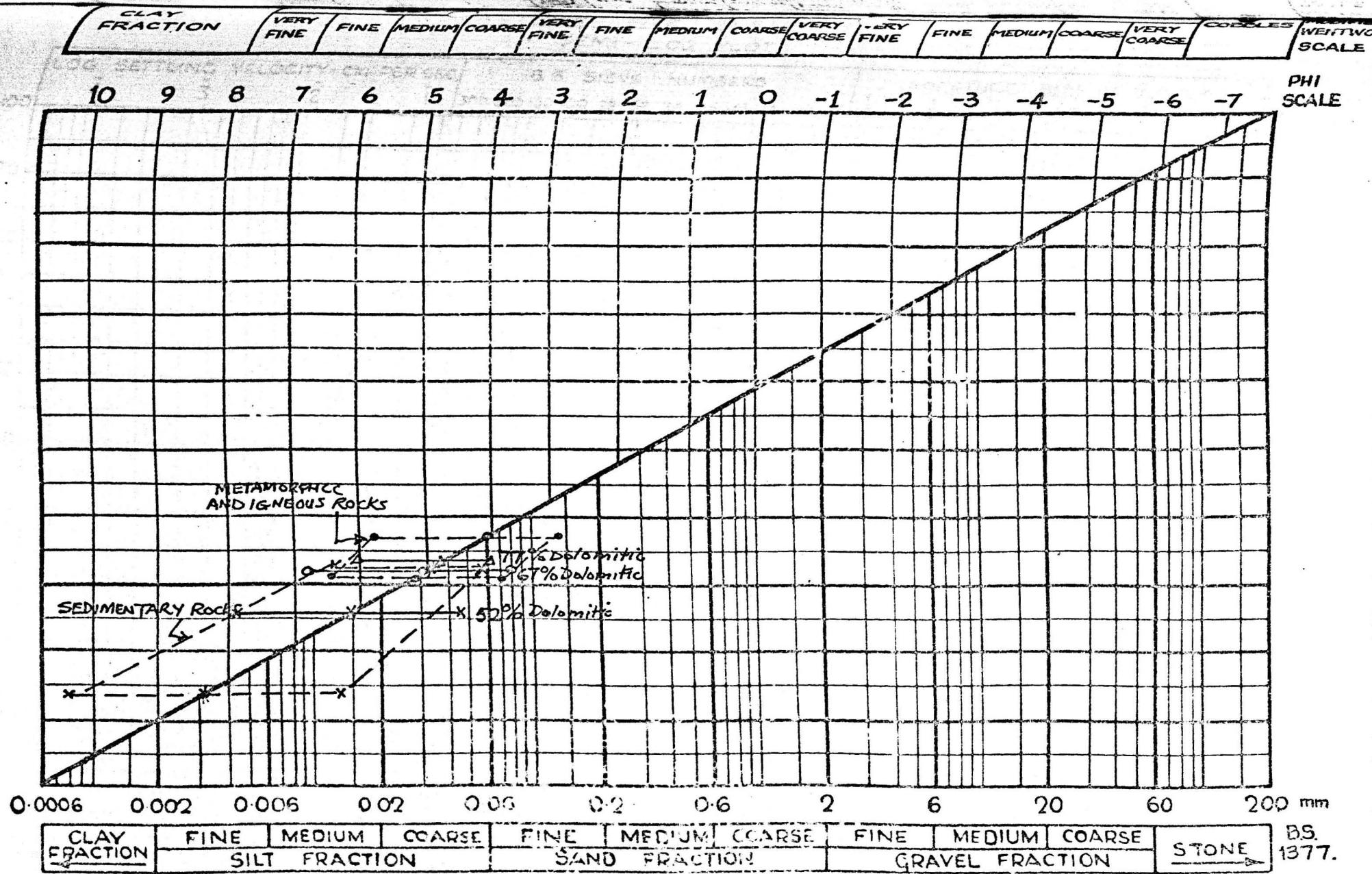


FIG 5.128. TEXTURAL CLASSIFICATION BASED ON  $Q_i$ ,  $M_d$ ,  $Q_3$  FOR CANADIAN TILLS (after DREIMAN)

PARTICLE SIZE DISTRIBUTION  
SEMI - LOG PLOT

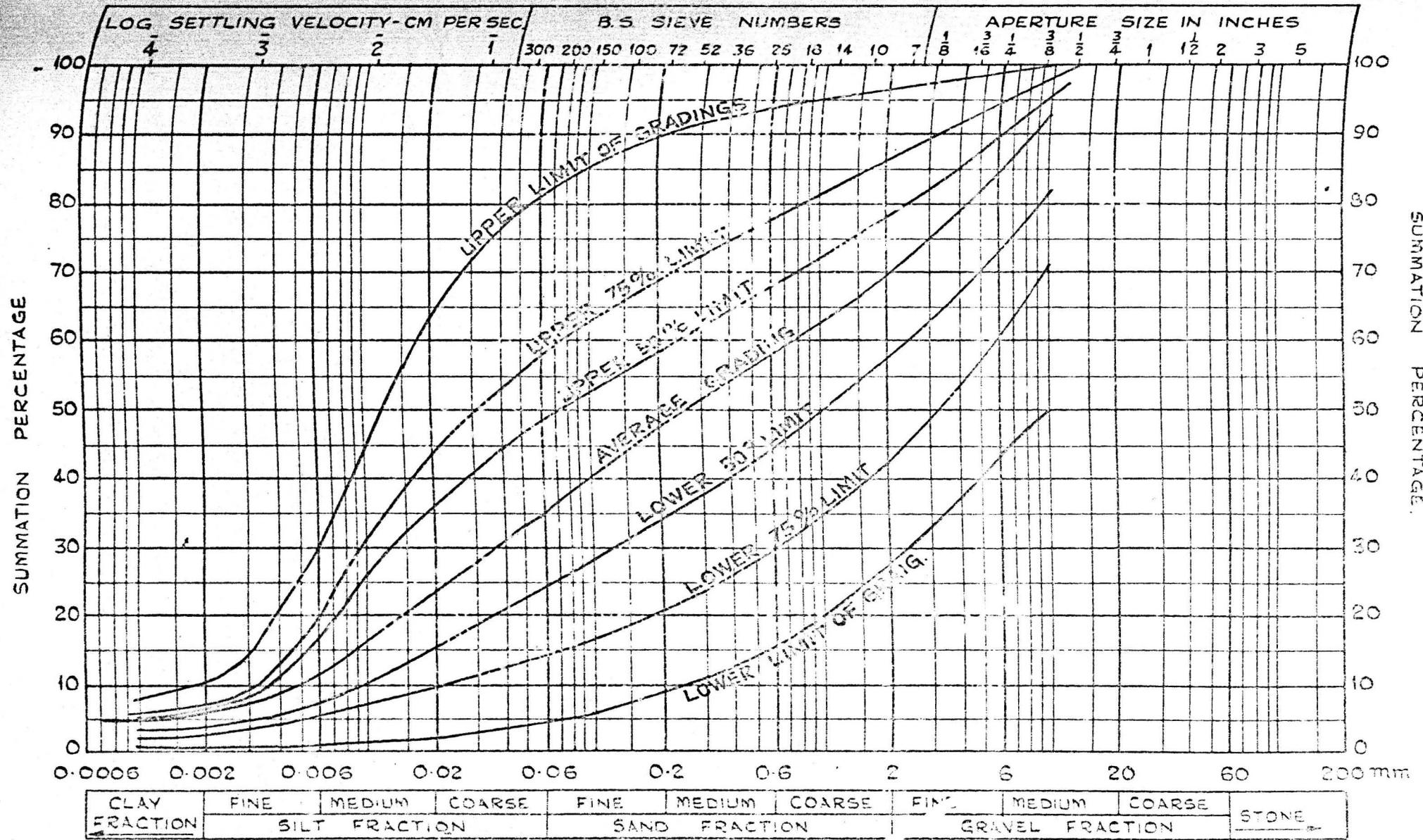


FIG.5.129. GRADINGS FROM VILLE LA SALLE, LACHINE MONTREAL TILLS.

PARTICLE SIZE DISTRIBUTION

SEMI-LOG PLOT

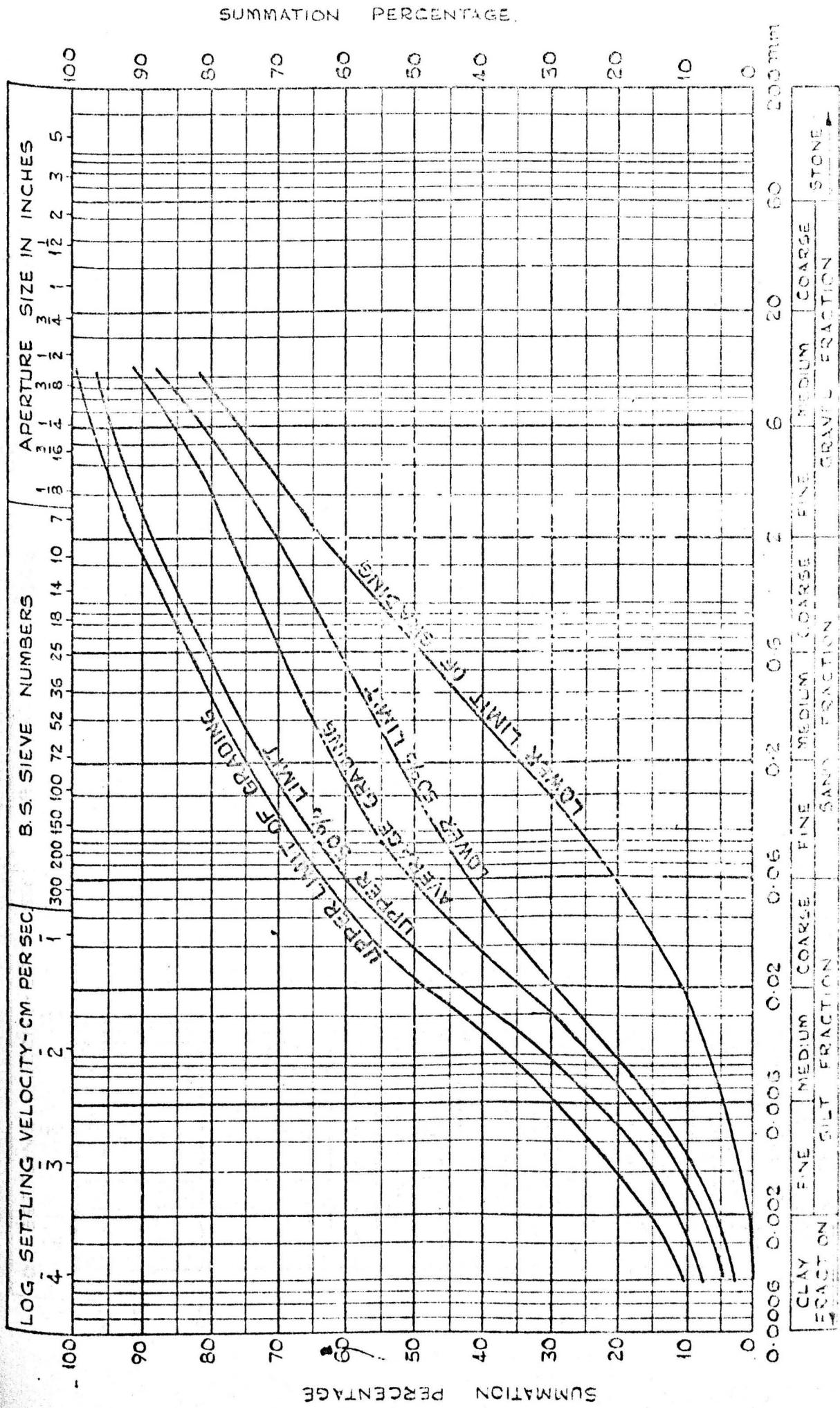
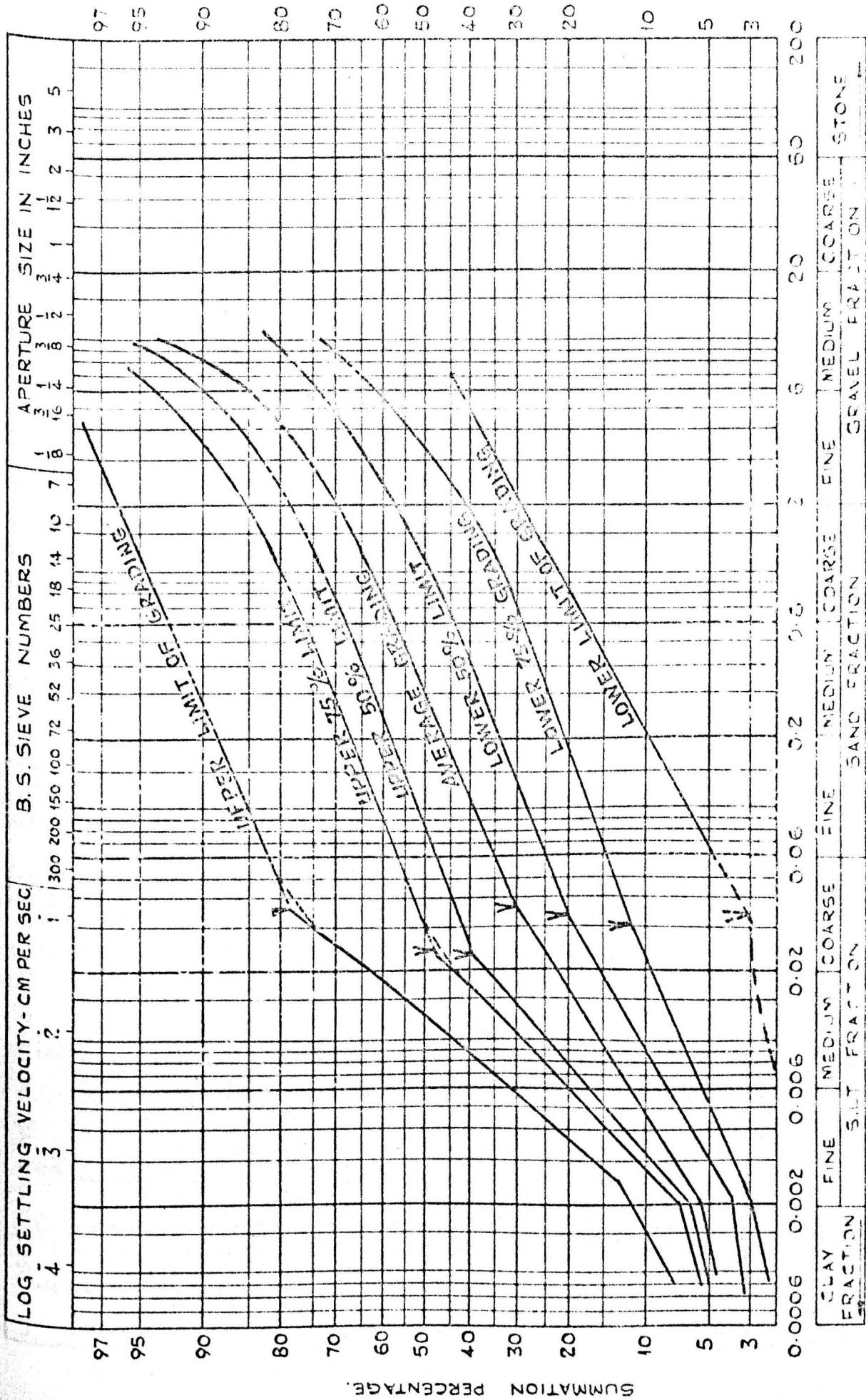


FIG. 5.130. GRADINGS FROM THE MEGAN, RIVER NORD MONTREAL TILL.

PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT



PARTICLE SIZE DISTRIBUTION

LOG PROBABILITY PLOT

SUMMATION PERCENTAGE.

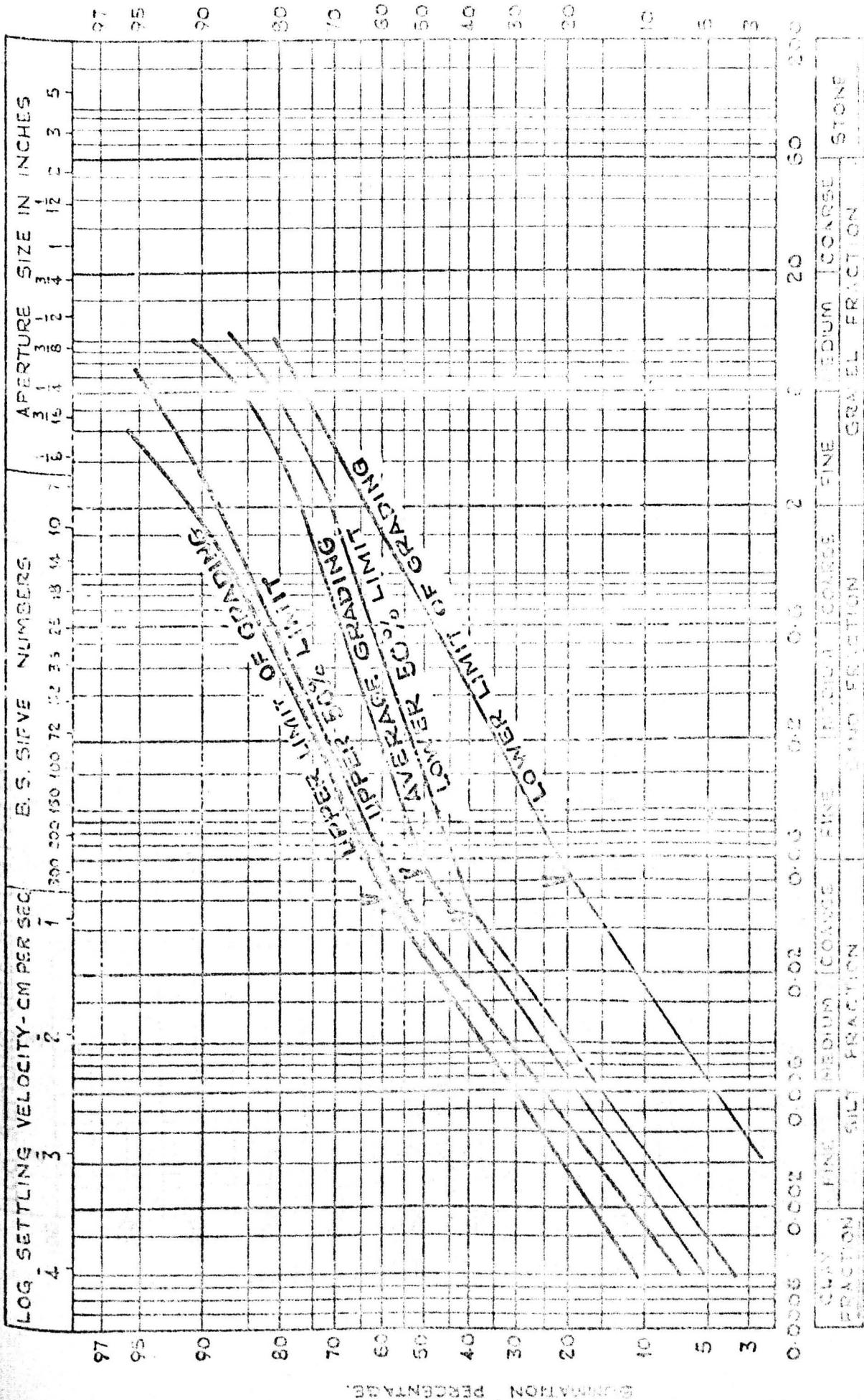


Fig. 7. Log Probability Plot of Particle Size Distribution.

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

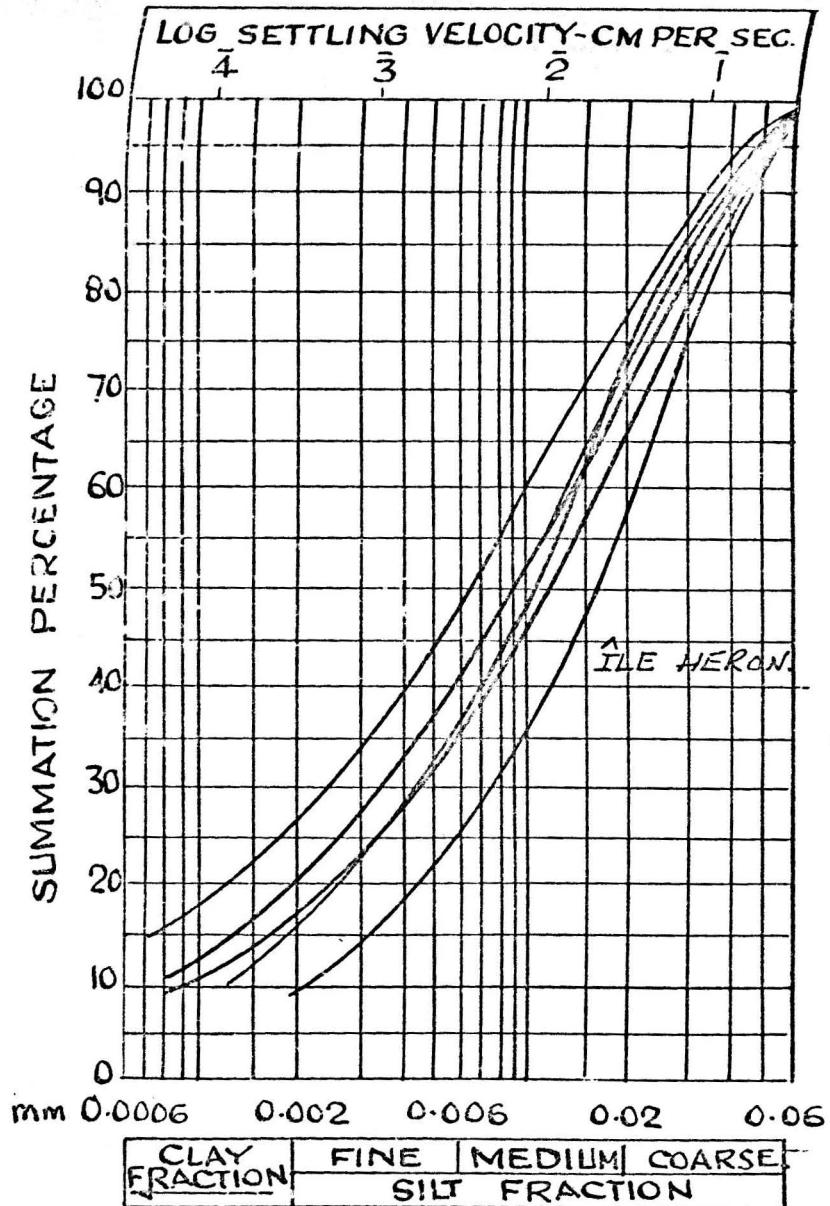
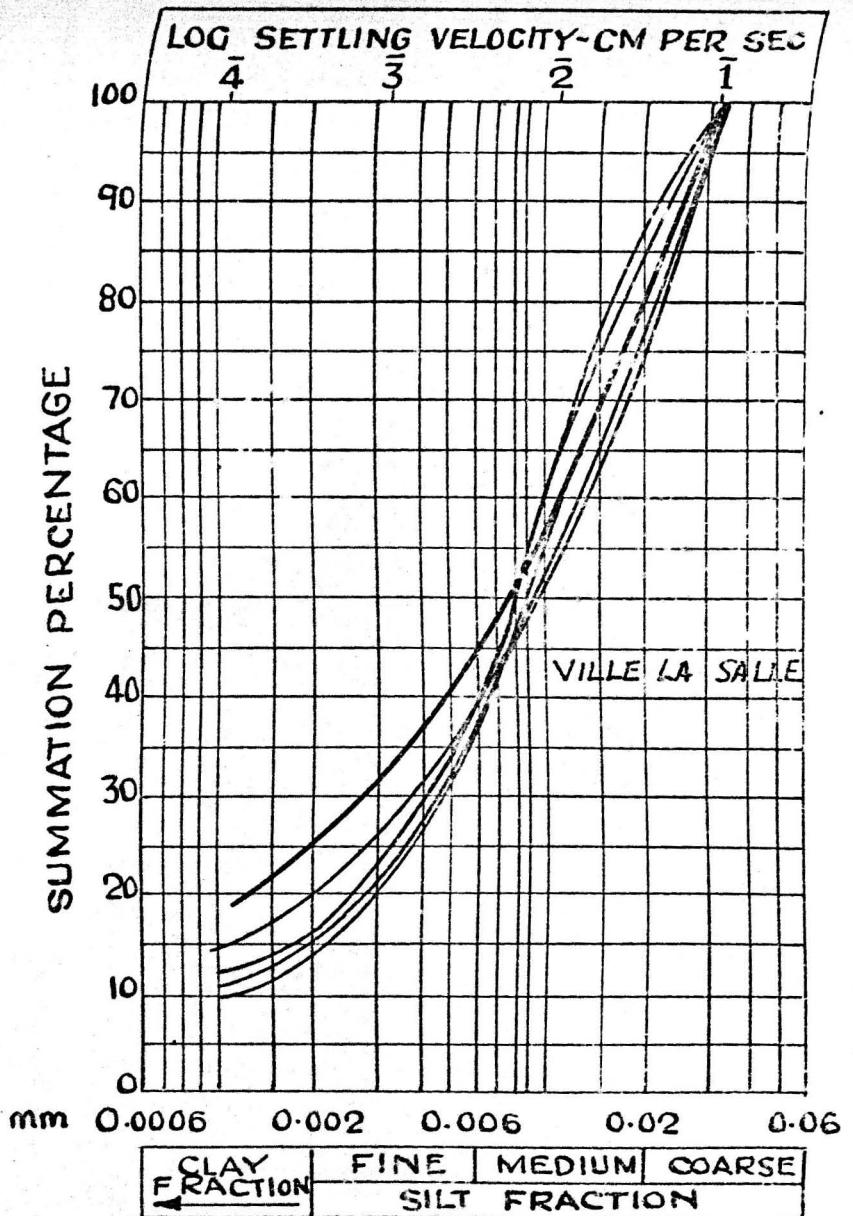


FIG. 5.133

FINE SOIL FRACTIONS OF MONTREAL TILLS.

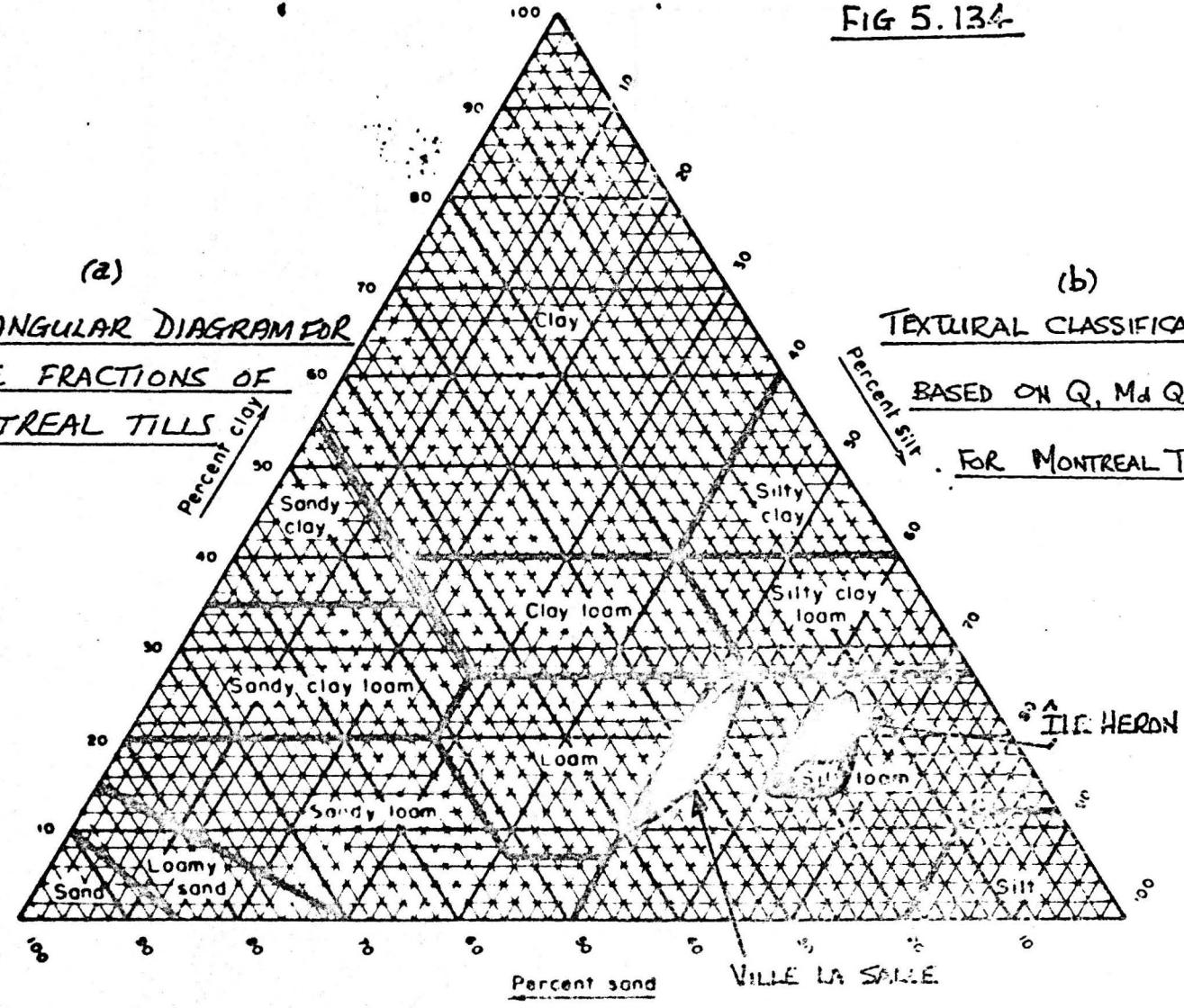
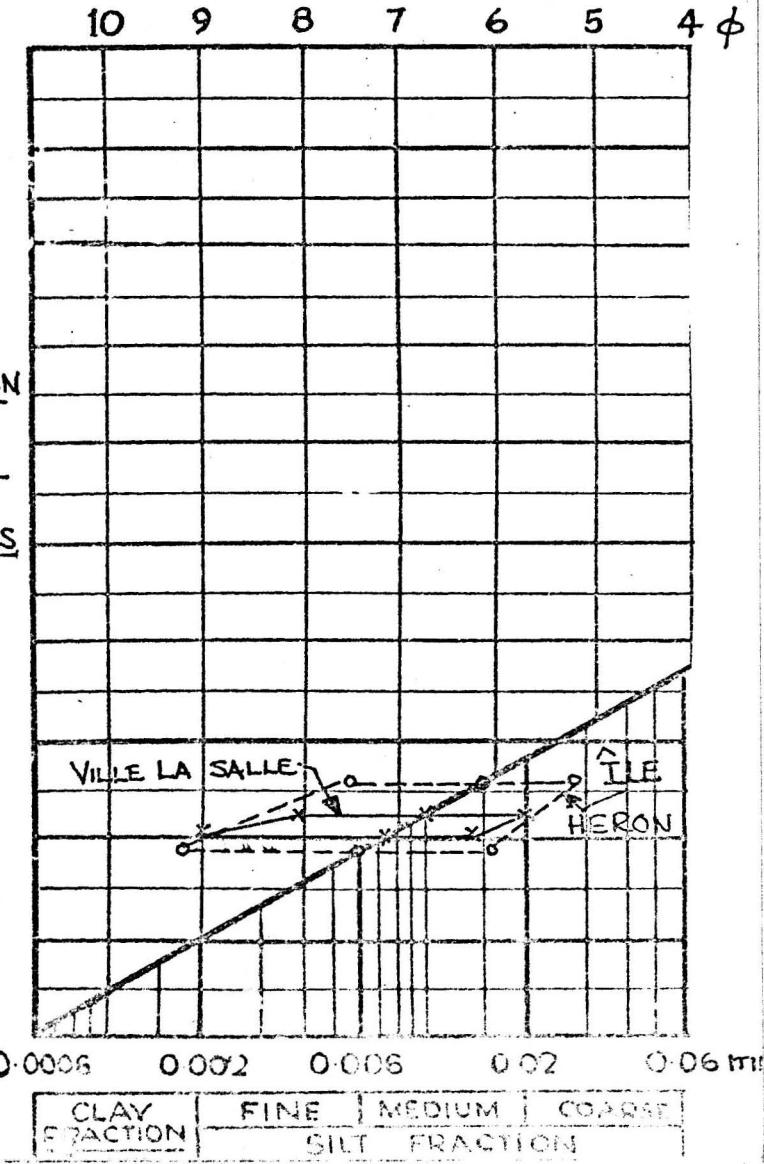
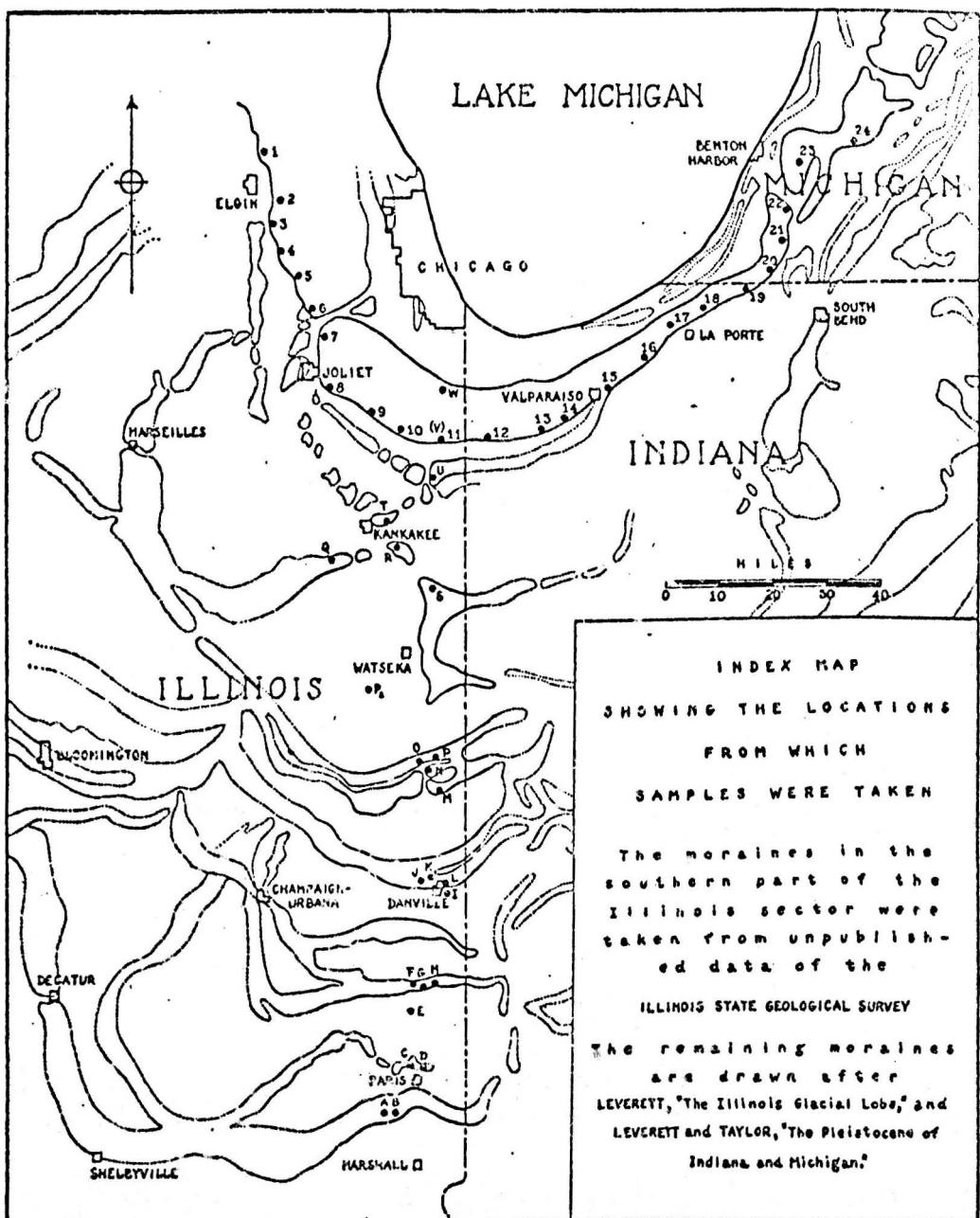


FIG 5.134

CLAY FRACTION	SILT			
	VERY FINE	FINE	MEDIUM	COARSE





**FIG. 5.135. LOCATION MAP FOR KRUMBEIN'S SAMPLES.  
(KRUMBEIN, 1953)**

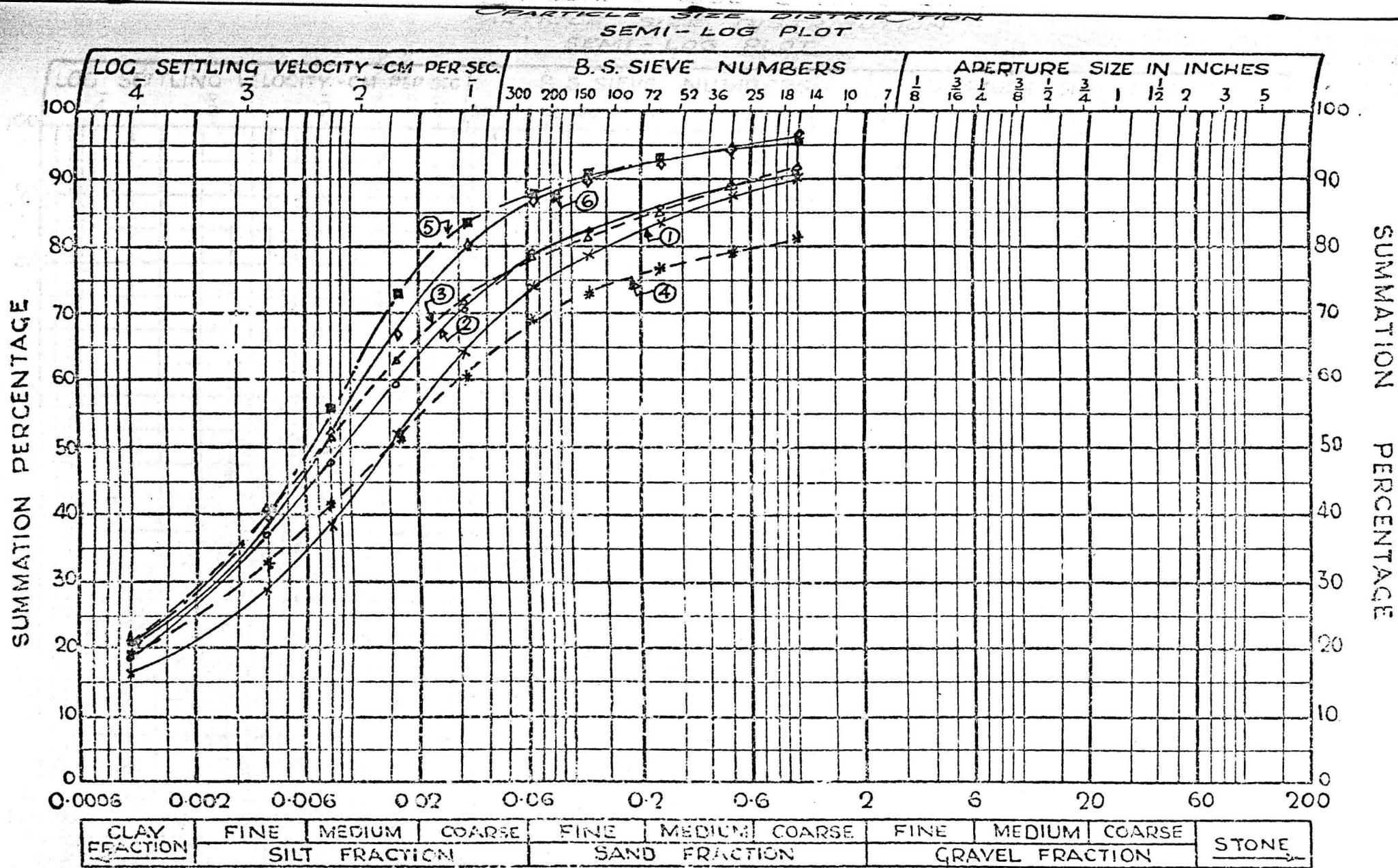


FIG 5136. GRADINGS FOR KRUMBEIN'S VALPARAISO TILLS (1-5)

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

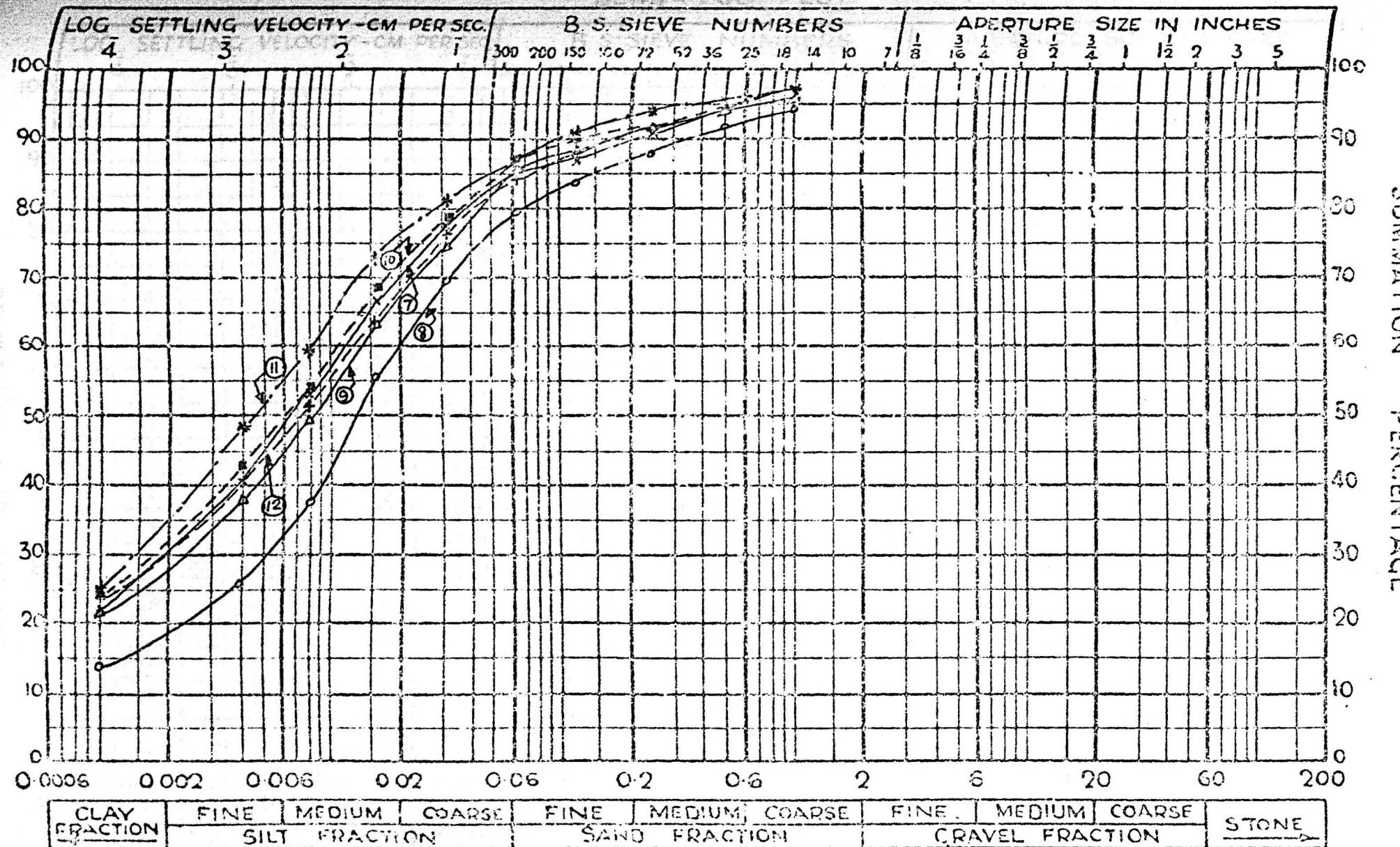


FIG. 5.137. GRADINGS FOR KRUMBEIN'S VALPARAISO TILLS (7-12)

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

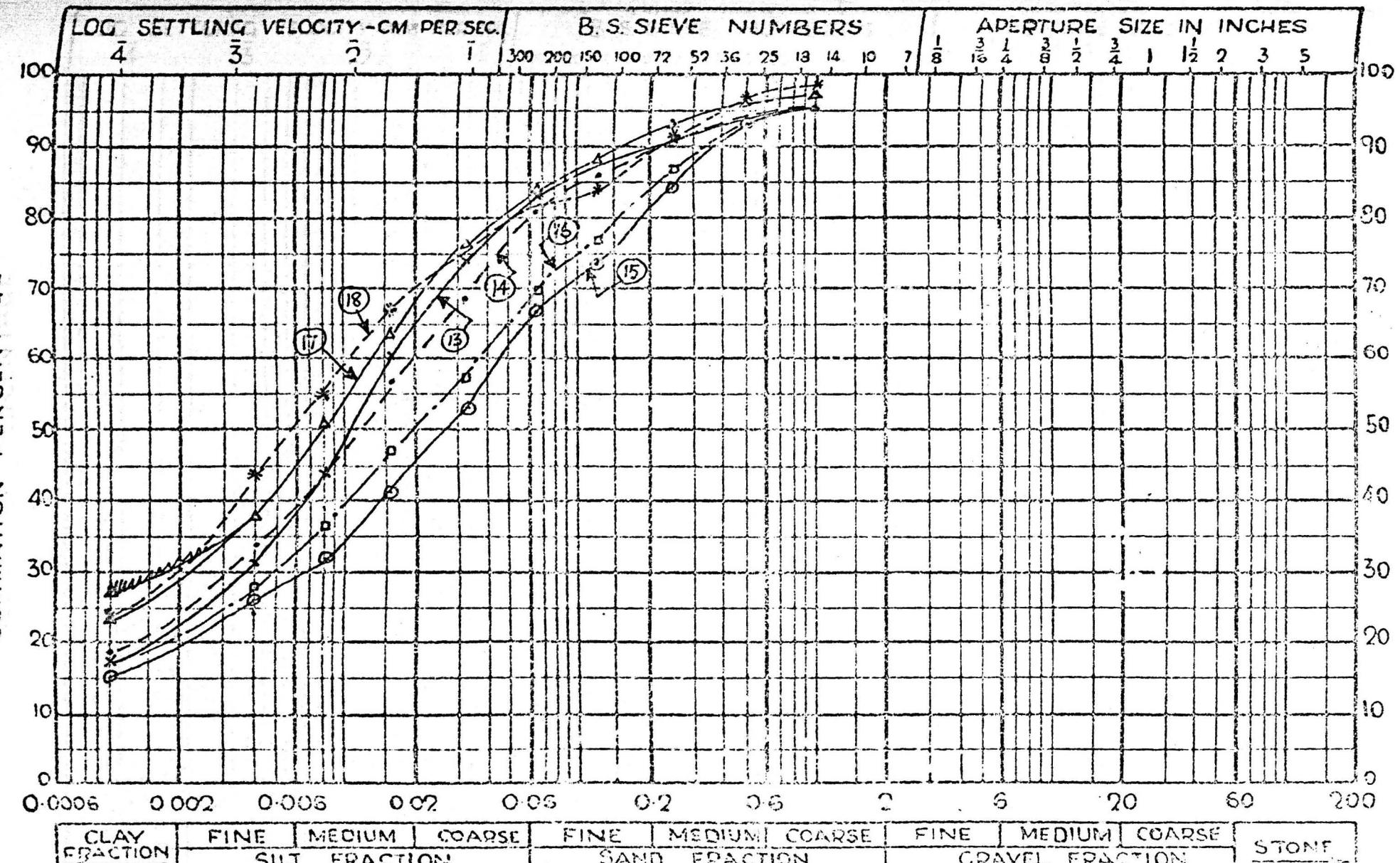


FIG. 5. 138. GRADINGS FOR KRUMBEIN'S VALPARAISO TILLS (13-18).

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

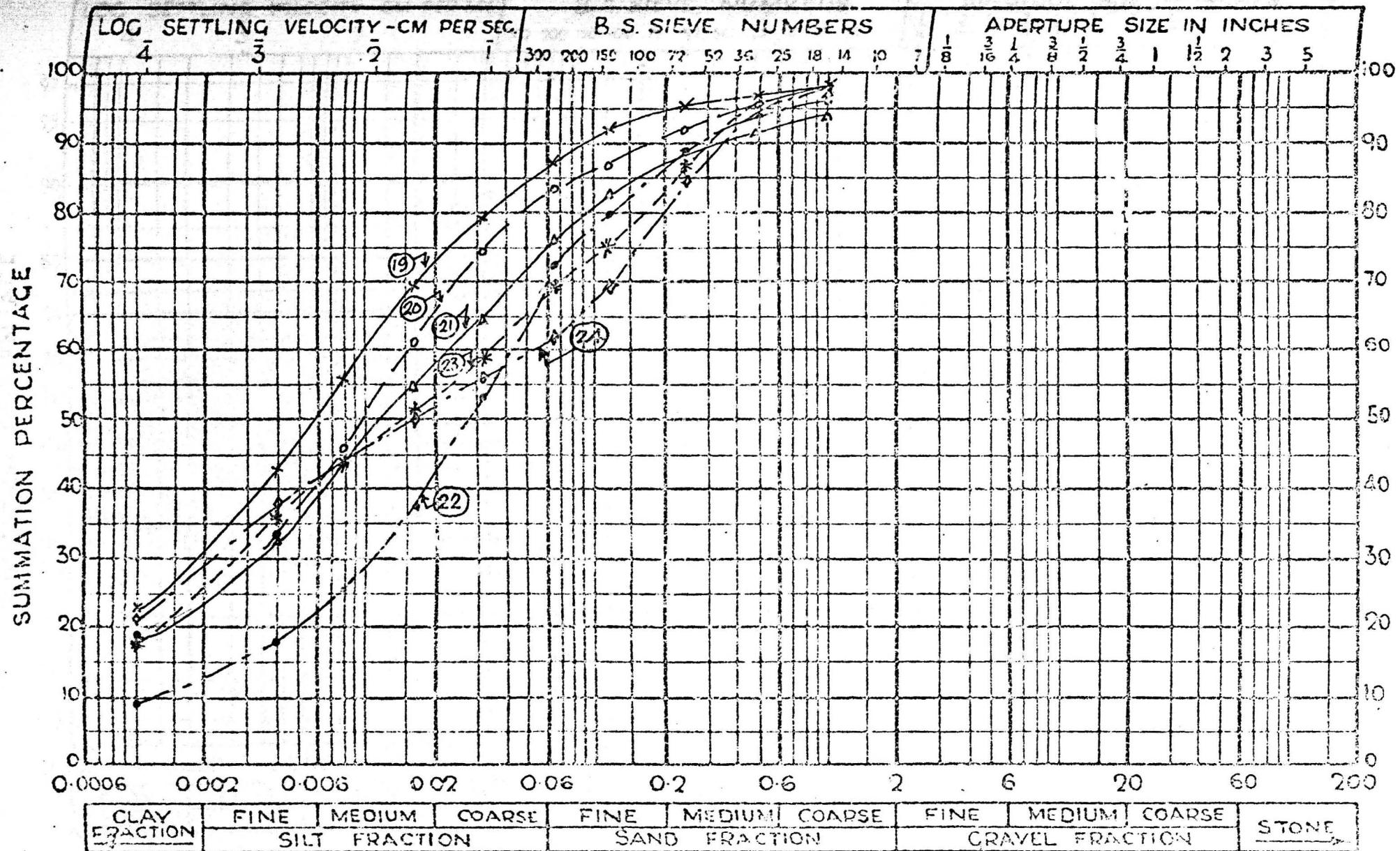


FIG. 5.139 GRADINGS FOR KRUMBEIN'S VALPARAISO TILLS (19-24).

PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT

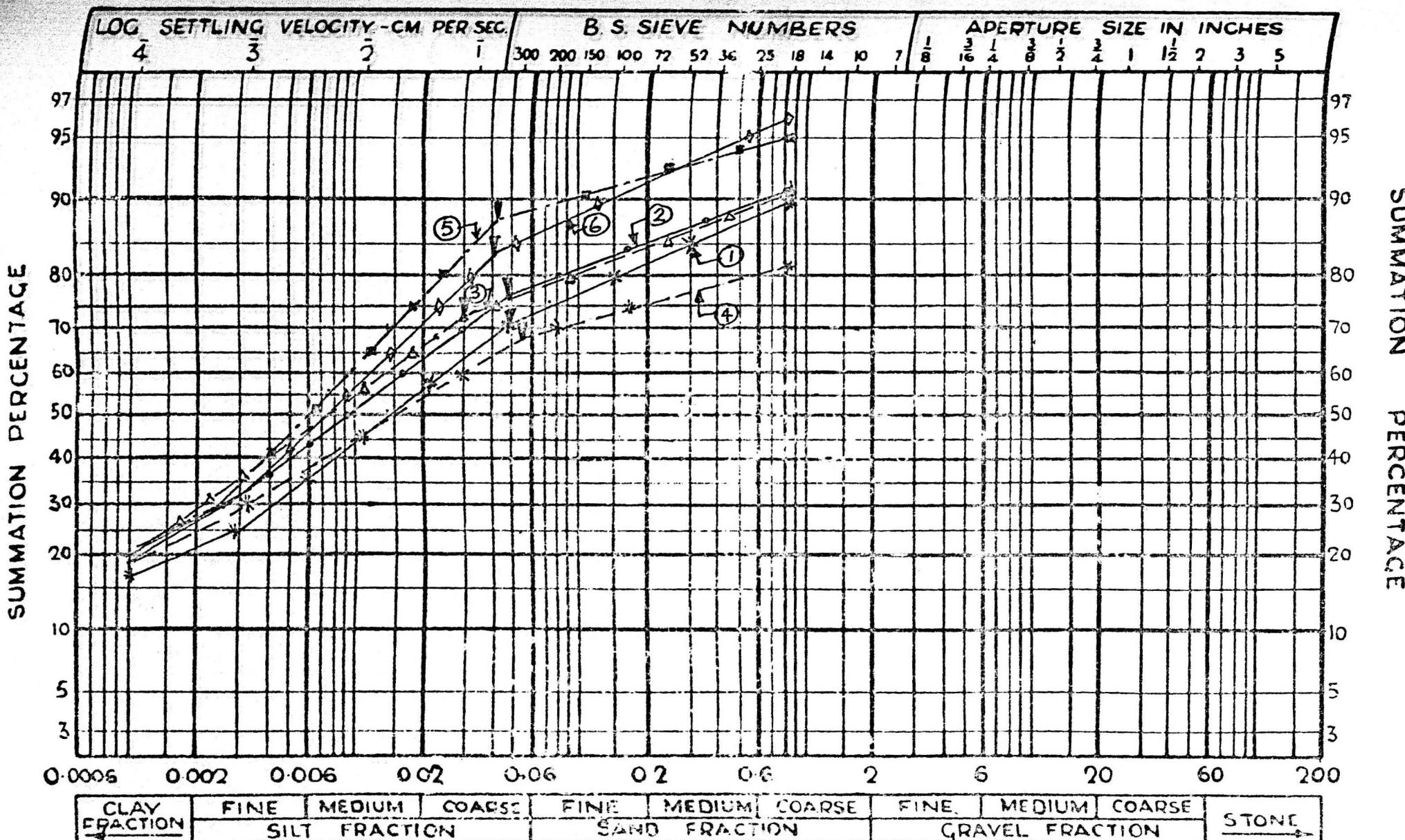


FIG. 5.140. LOG PROBABILITY PLOT OF KRUMBEIN VALPARAISO TILLS (1-5).

PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT

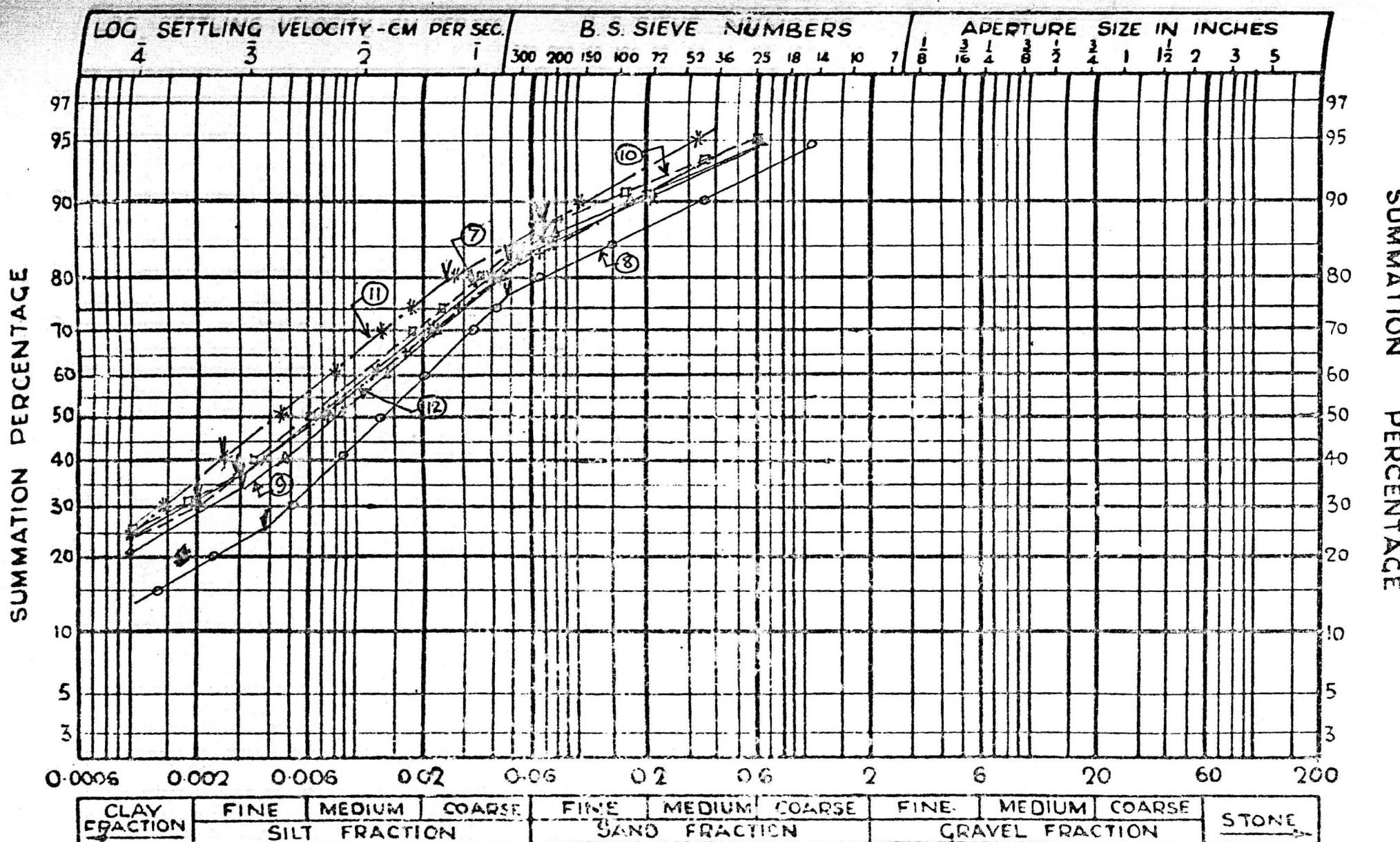


FIG. 5.14I. LOG PROBABILITY PLOT OF KRUMBEIN'S VALPARAISO TILLS (7-12).

PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT

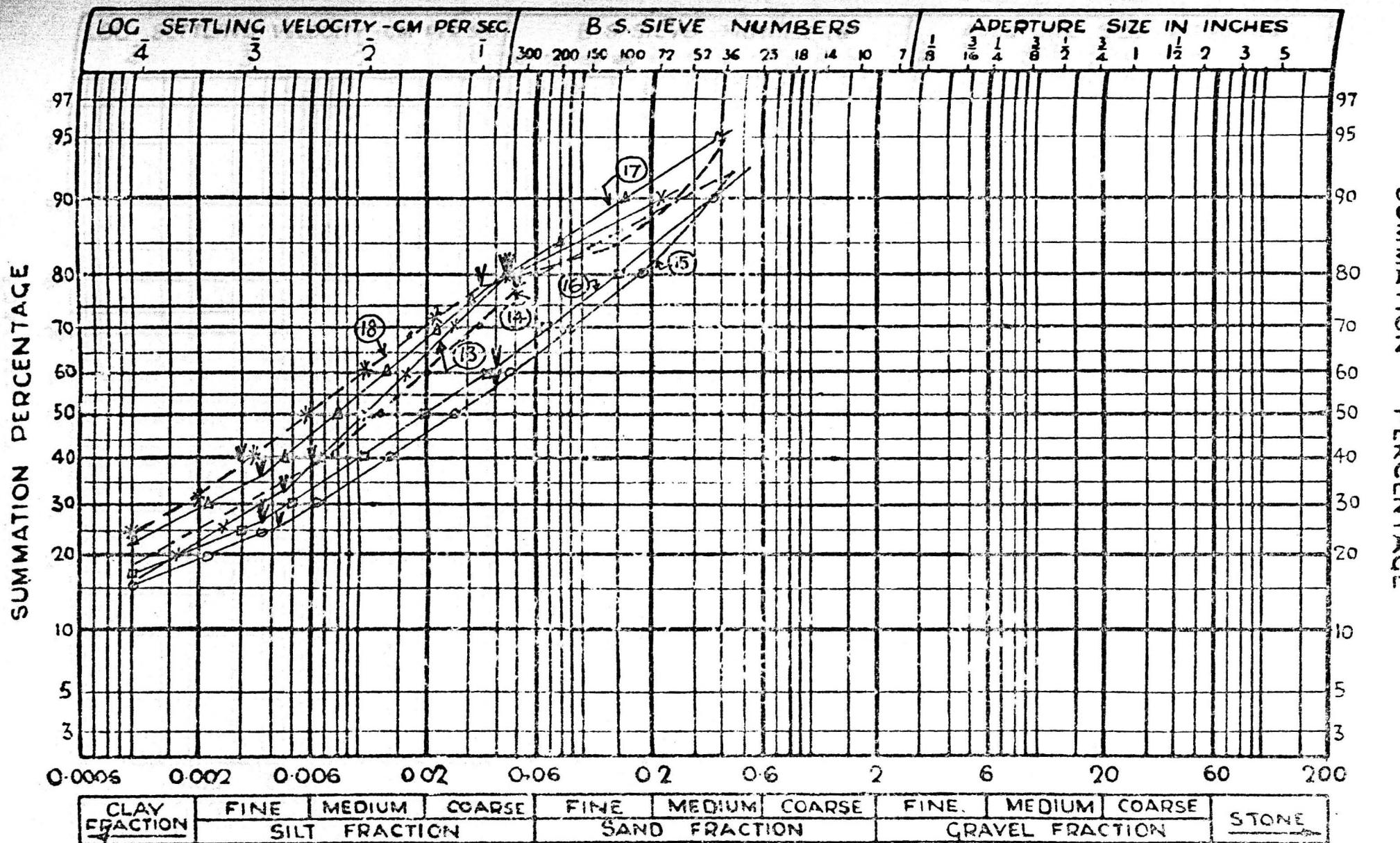


FIG. 5.142. LOG PROBABILITY PLOT OF KRUMBEIN'S VALPARAISO TILLS (13-18).

PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT

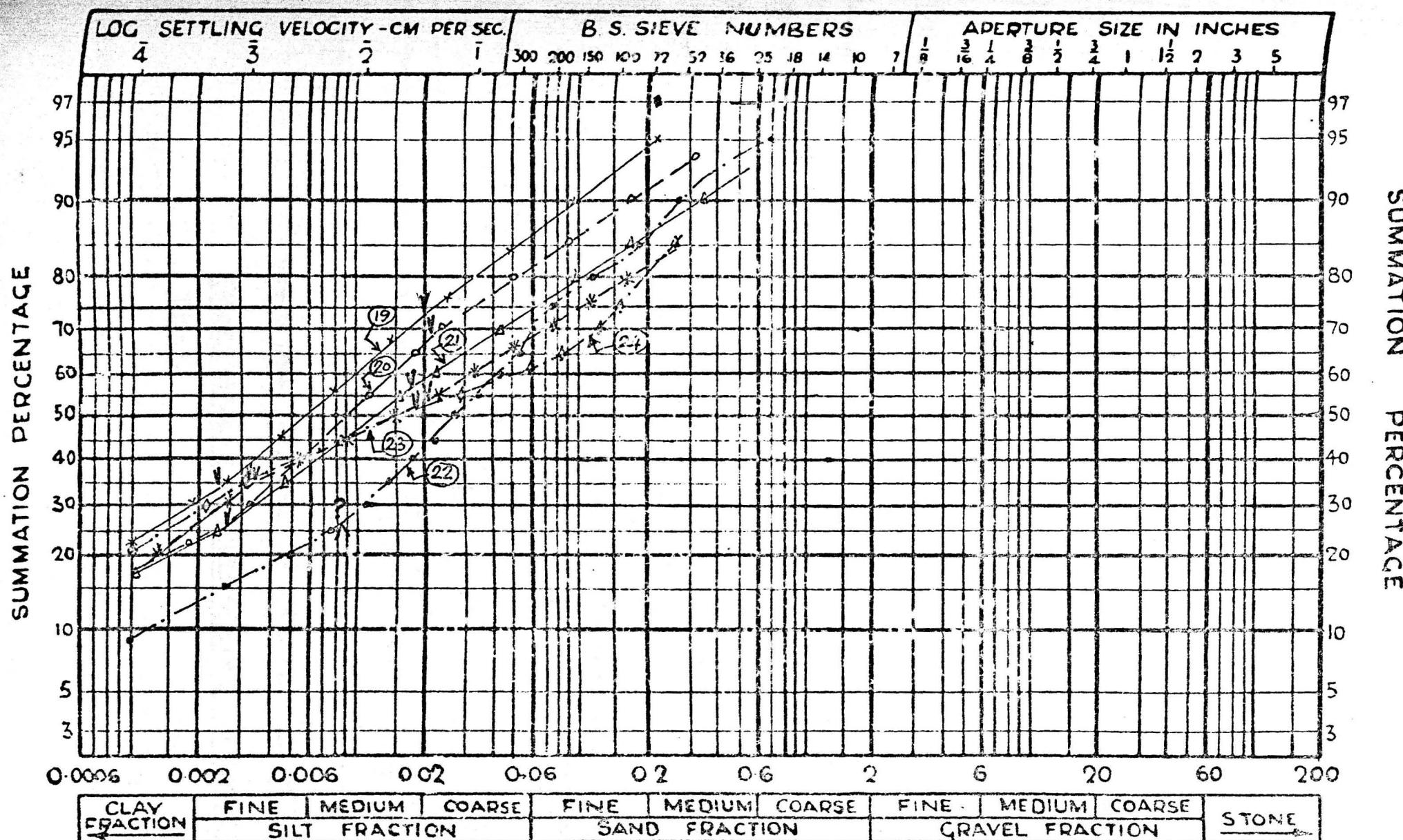


FIG. 5.143. LOG PROBABILITY PLOT OF KRUMBEIN'S VALPARAISO TILLS (19-24).

PARTICLE SIZE DISTRIBUTION  
SEMI - LOG PLOT

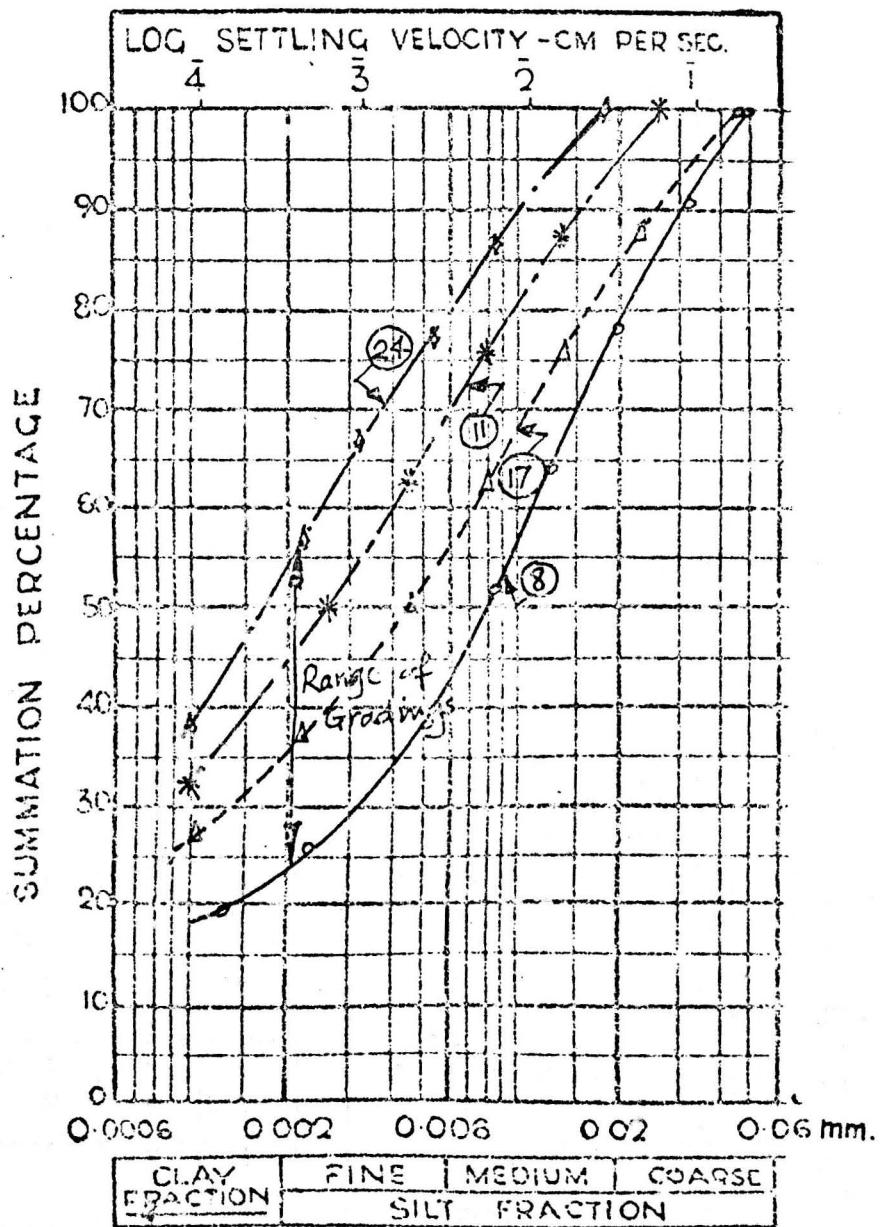


FIG. 5.144. RANGE OF GRADINGS OF FINE FRACTIONS OF KRUMBEIN'S VALPARAISO TILLS

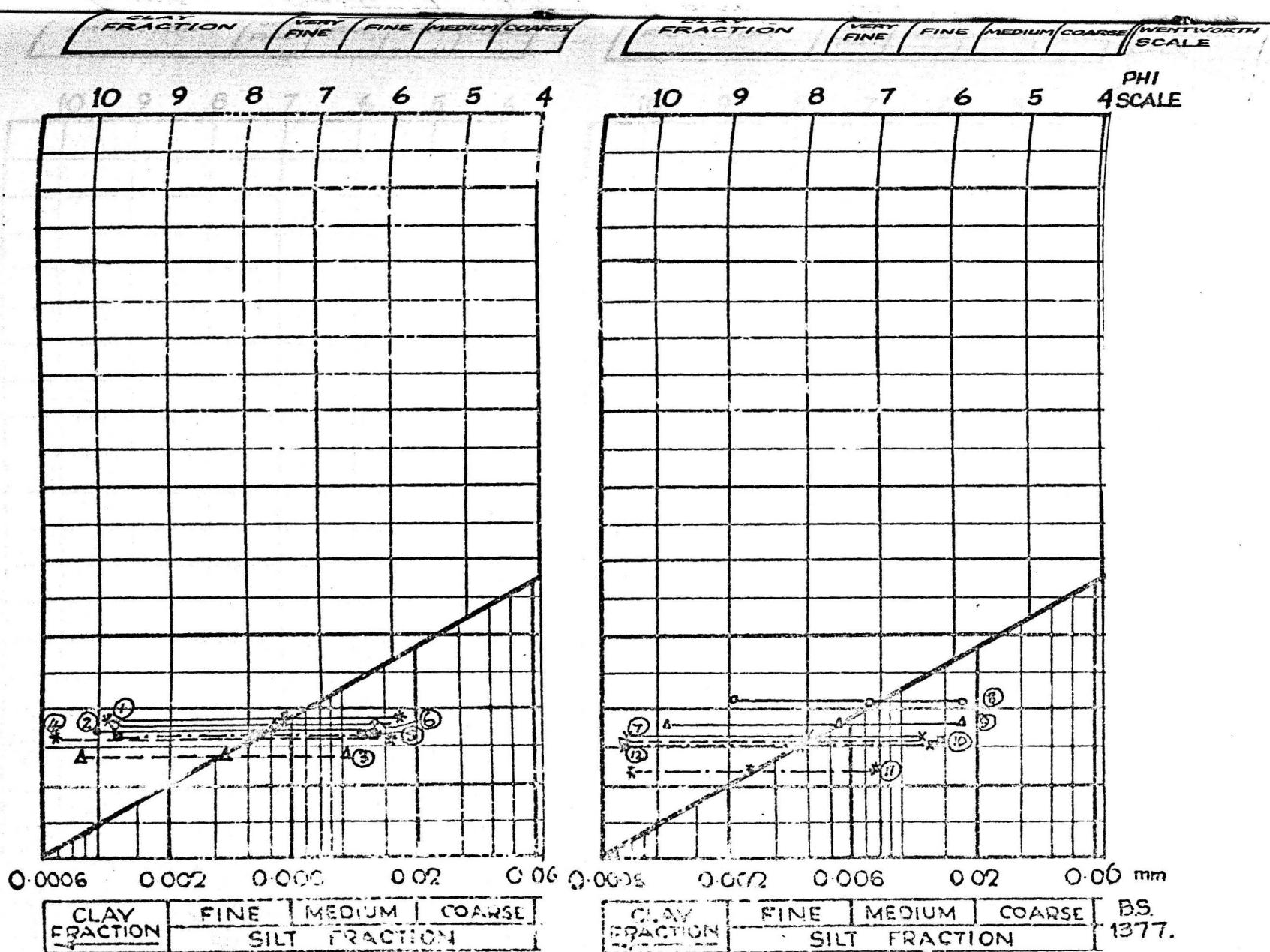


FIG. 5.145. TEXTURAL CLASSIFICATION BASED ON Q<sub>1</sub> MJ Q<sub>3</sub> FOR KRUMEIN'S VALPARAISO TILLS (1 - 12) FINE FRACTIONS

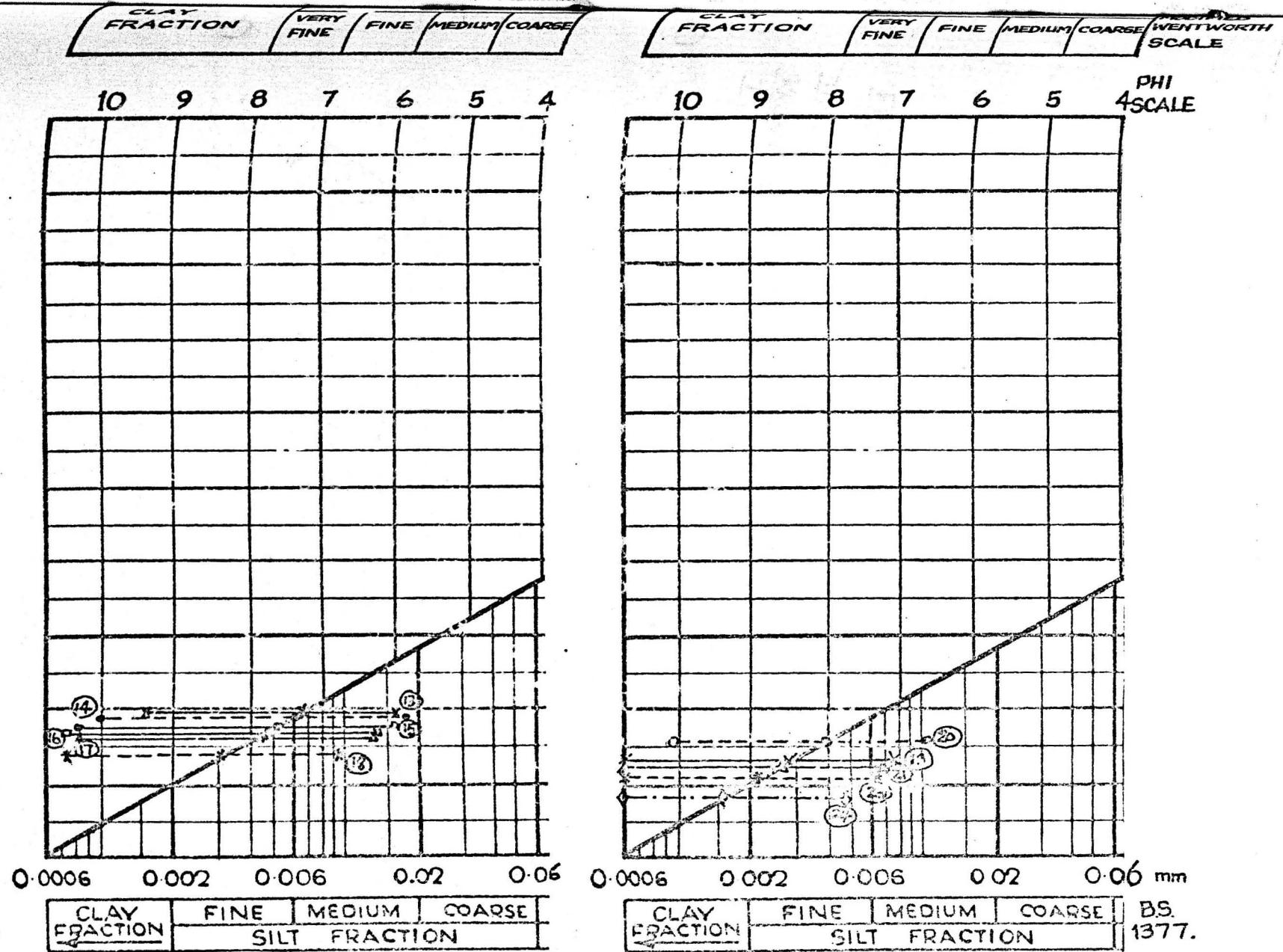


FIG. 5. 146 TEXTURAL CLASSIFICATION BASED ON  $Q_1$ ,  $M_d$ ,  $Q_3$  FOR

KRUMBEIN'S VALPARAISO TILLS (13-24) FINE FRACTIONS.

FIG. 5.147.

TRIANGULAR DIAGRAM FOR

KRUMBEIN'S VALPARAISO/ILLINOIS  
TILLS - FINE FRACTION

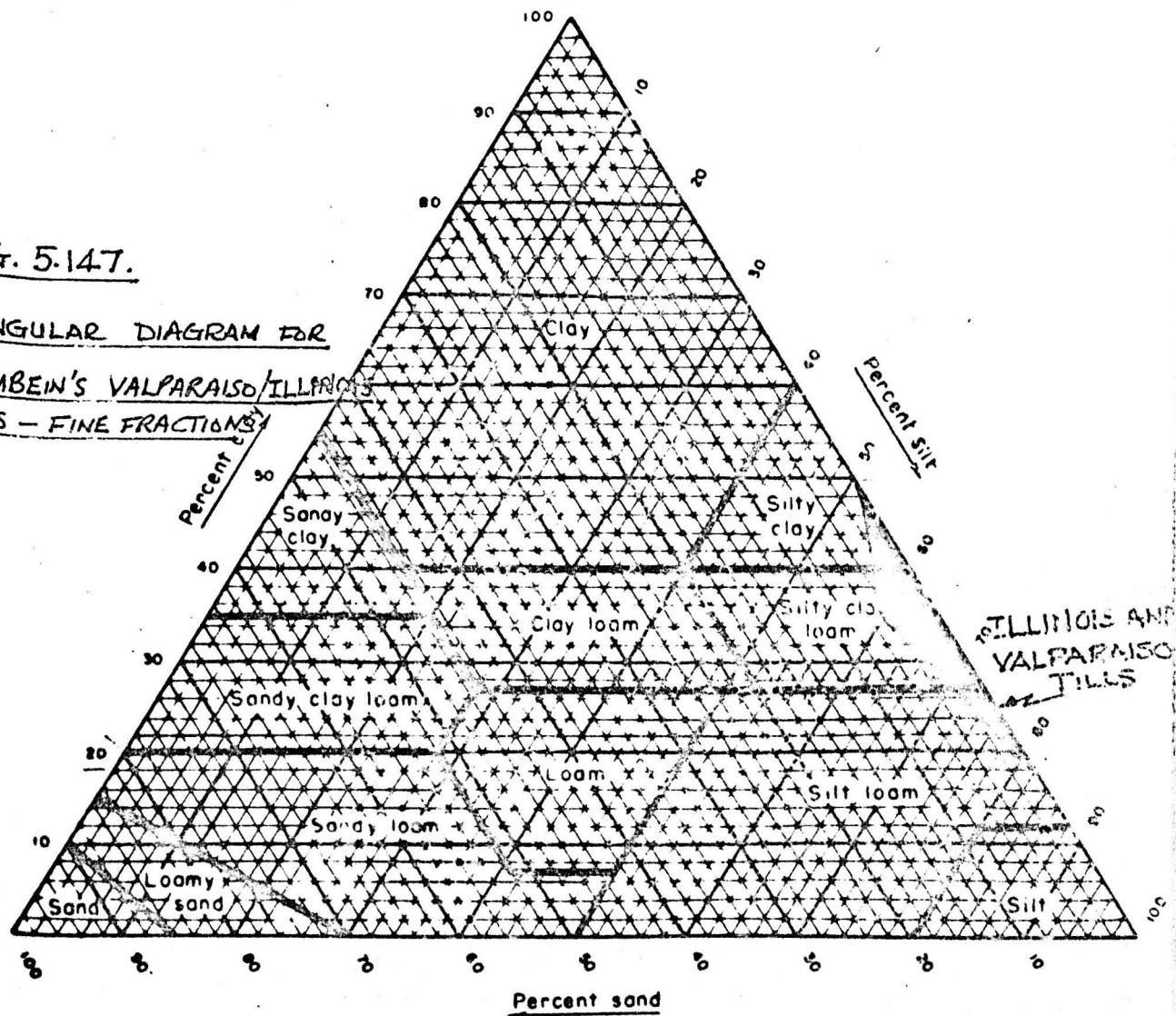


FIG. 5.148. LITHOLOGIC VARIATION IN VALPARAISO TILL (AFTER KRUMBEN, 1953).

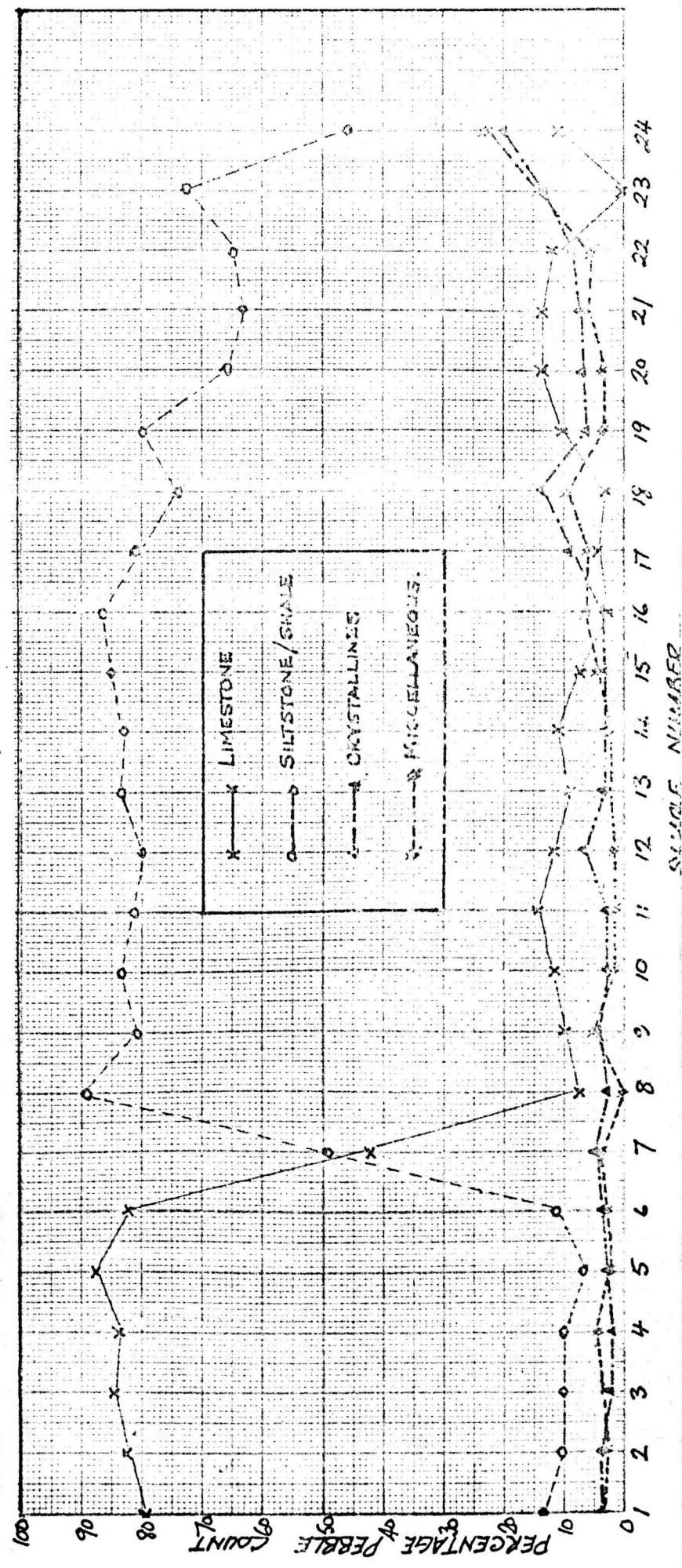
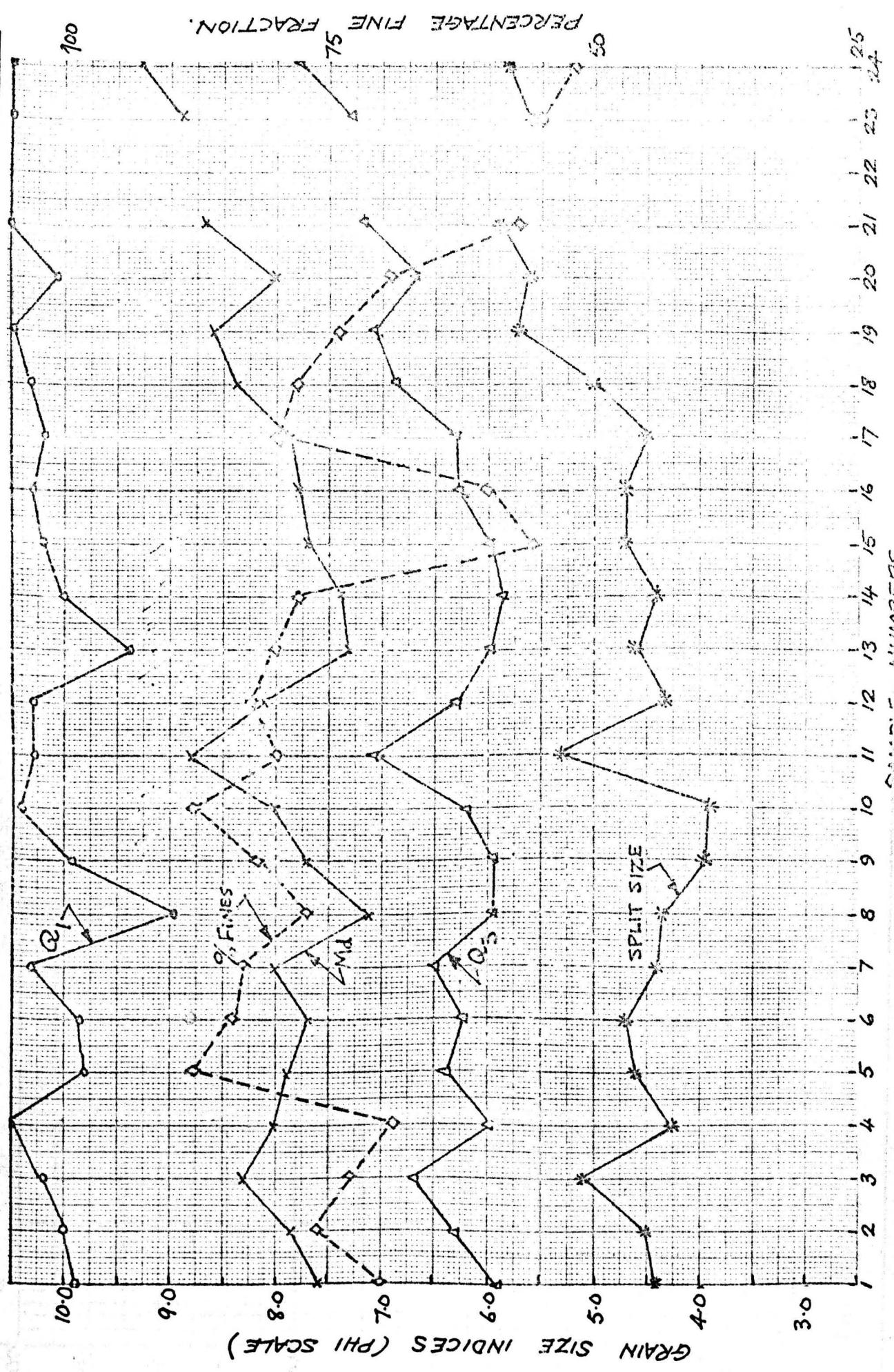


FIG. 5.14.9. VARIATION OF THE GRAIN SIZE INDICES AND FINES CONTENT IN VALPARAISO TILL



PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

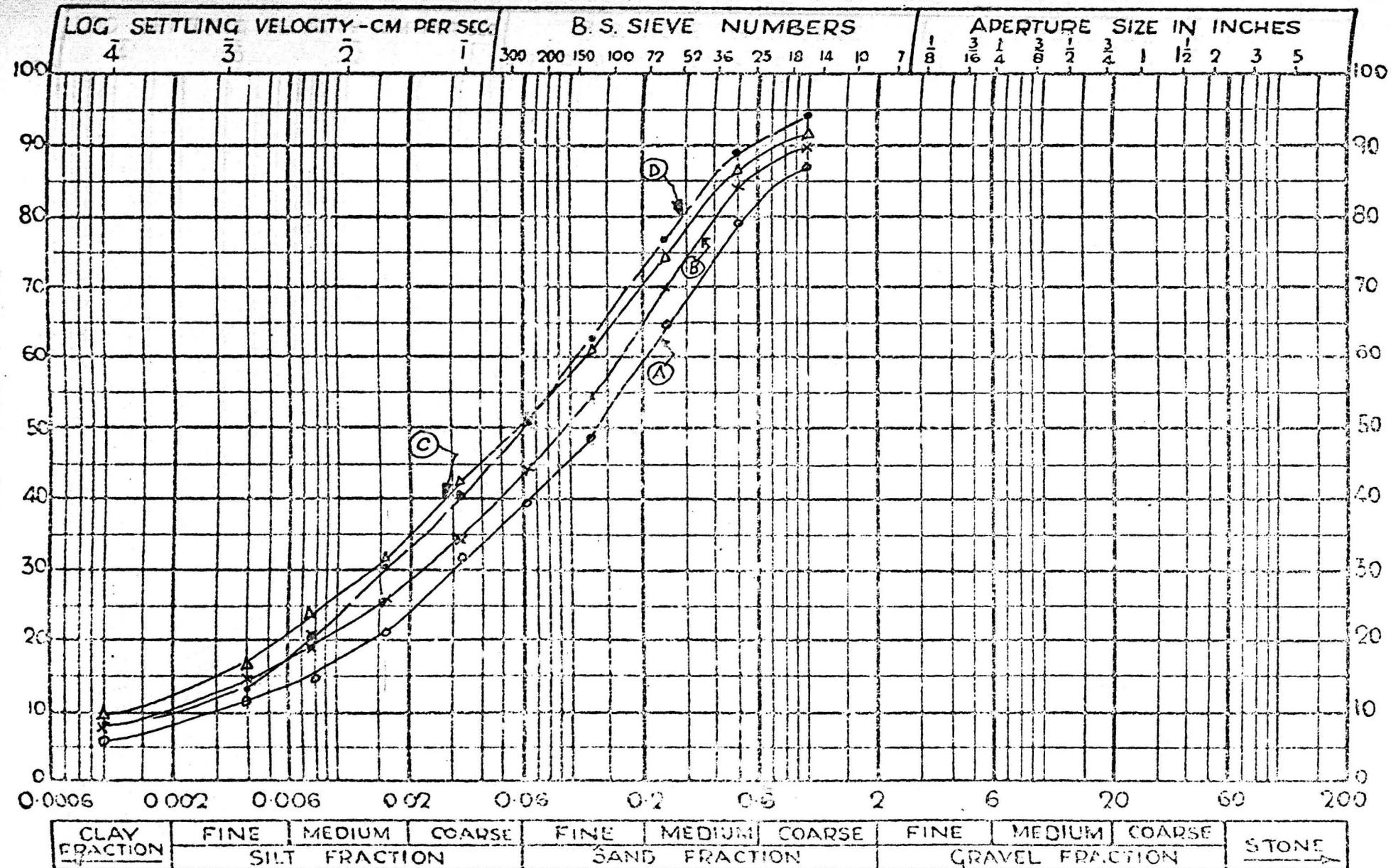


FIG. 5.150. GRADINGS FOR KRUMBEIN'S ILLINOIS TILLS (A-D).

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

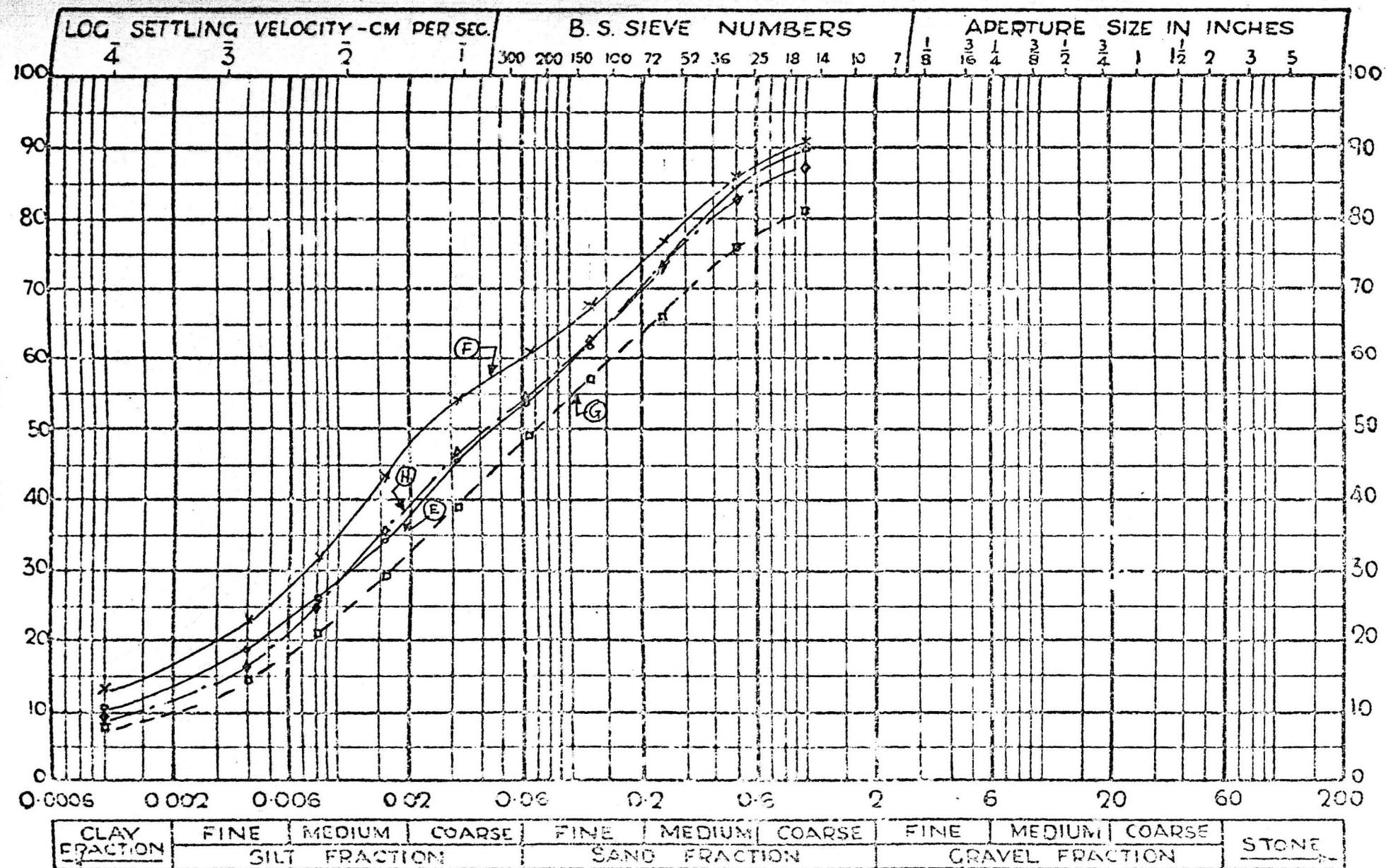


FIG. 5.151. GRADINGS FOR KRUMBEIN'S ILLINOIS TILLS (E-H).

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

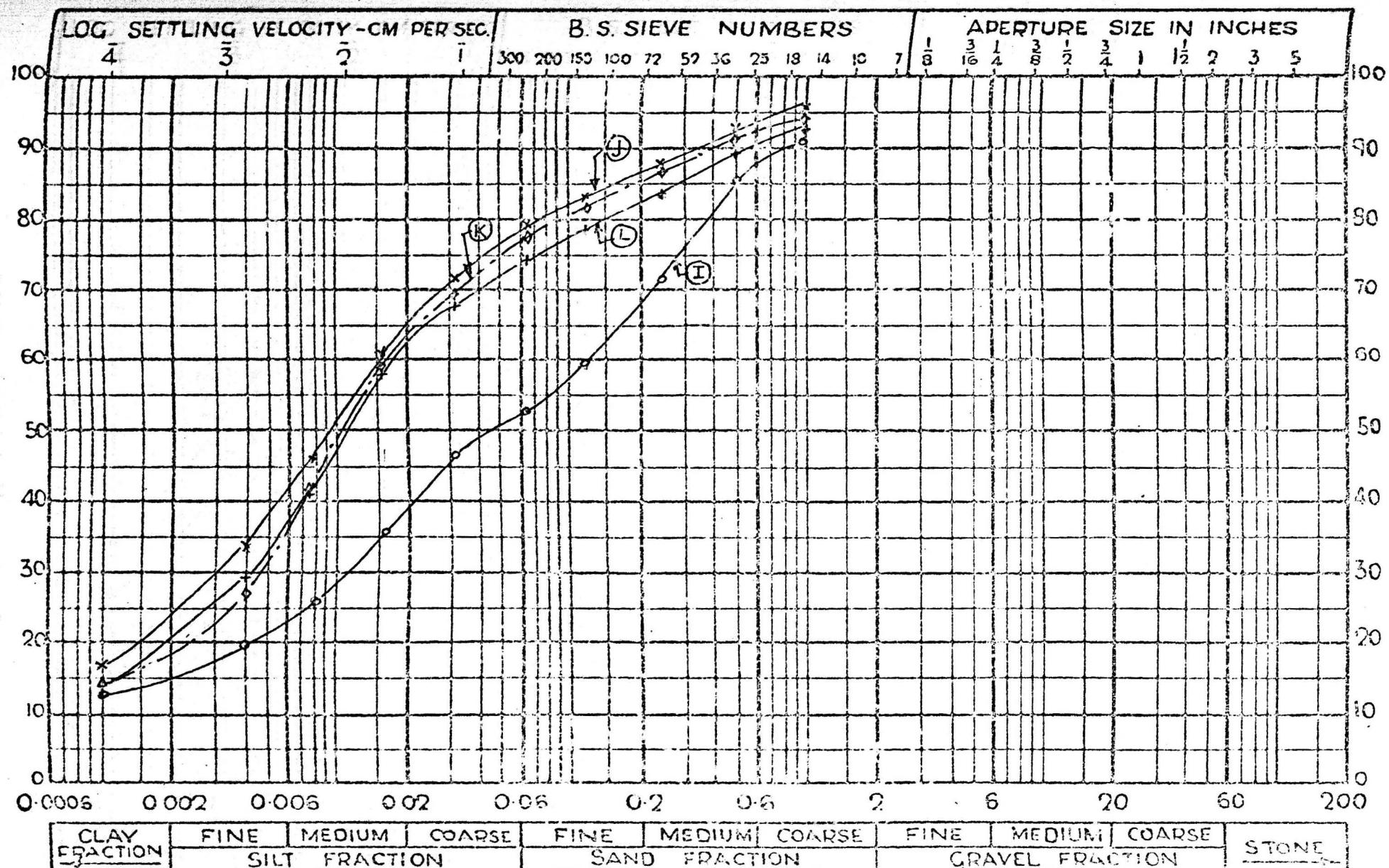


FIG. 5.152. GRADINGS FOR KRUMBEIN'S ILLINOIS TILLS (I-L).

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

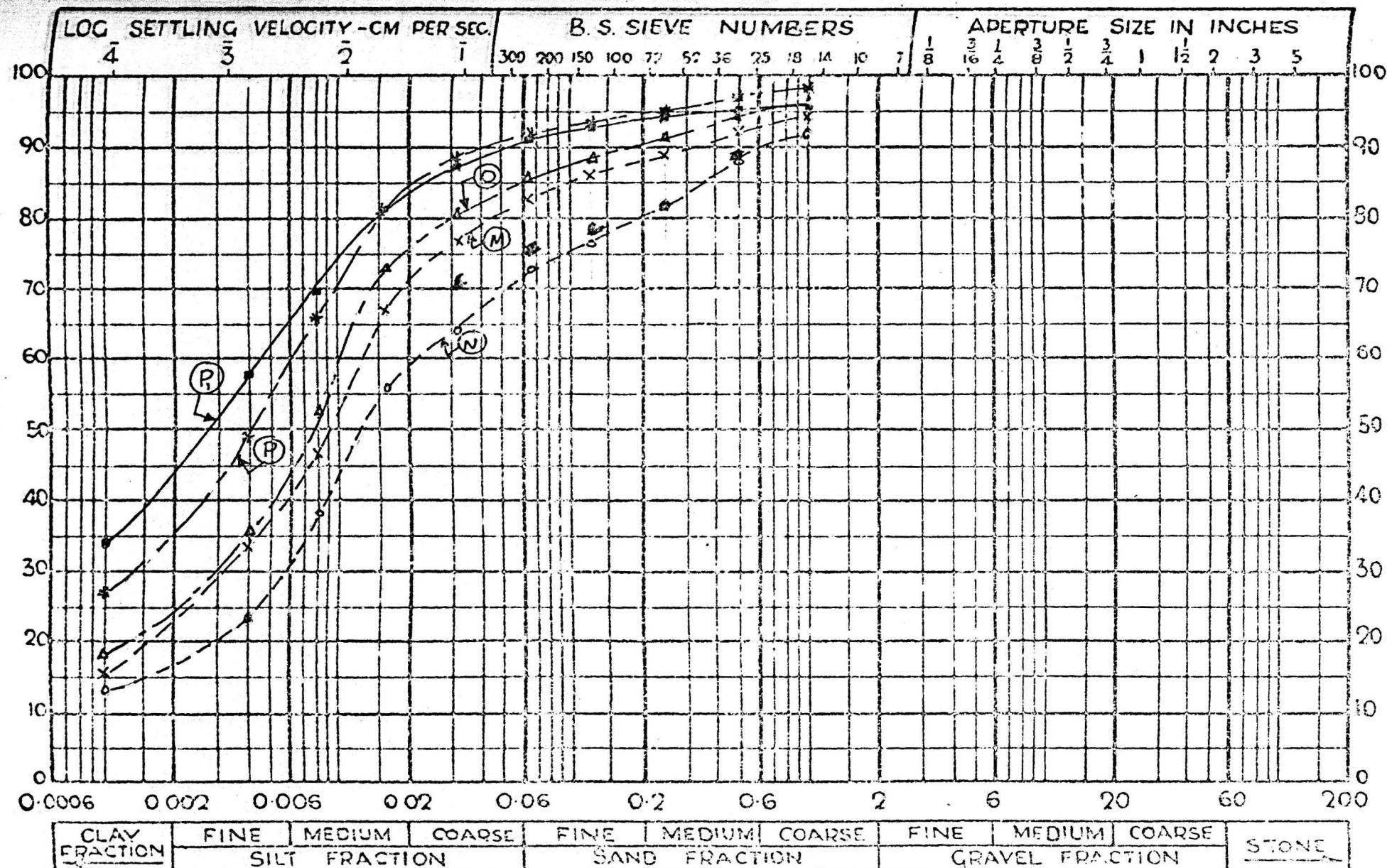


FIG. 5.153. GRADINGS FOR KRUMBEIN'S ILLINOIS TILLS (M-P<sub>1</sub>)

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

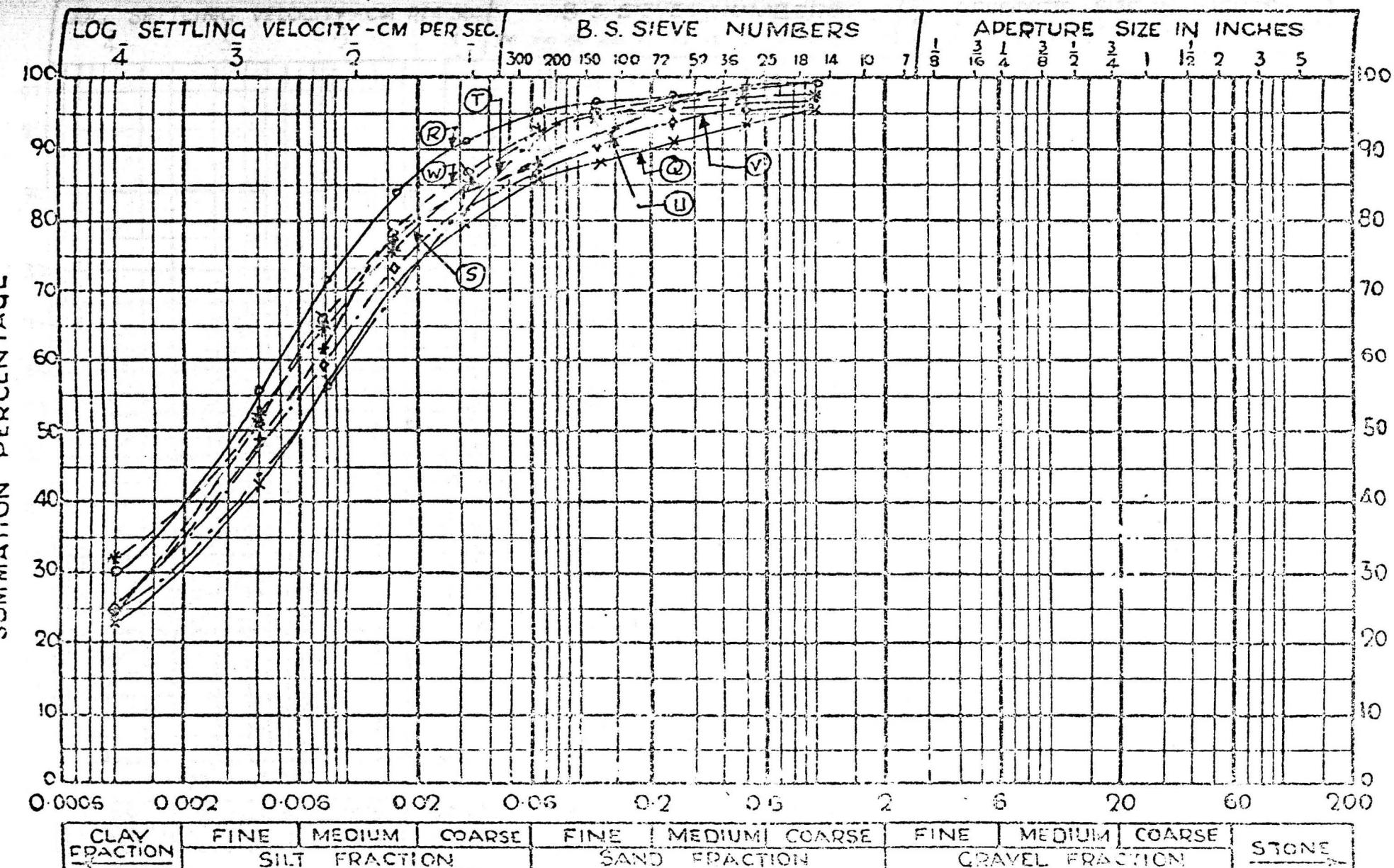


FIG. 5.154. GRADINGS FOR KRUMBEIN'S ILLINOIS TILLS (Q-V).

PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT

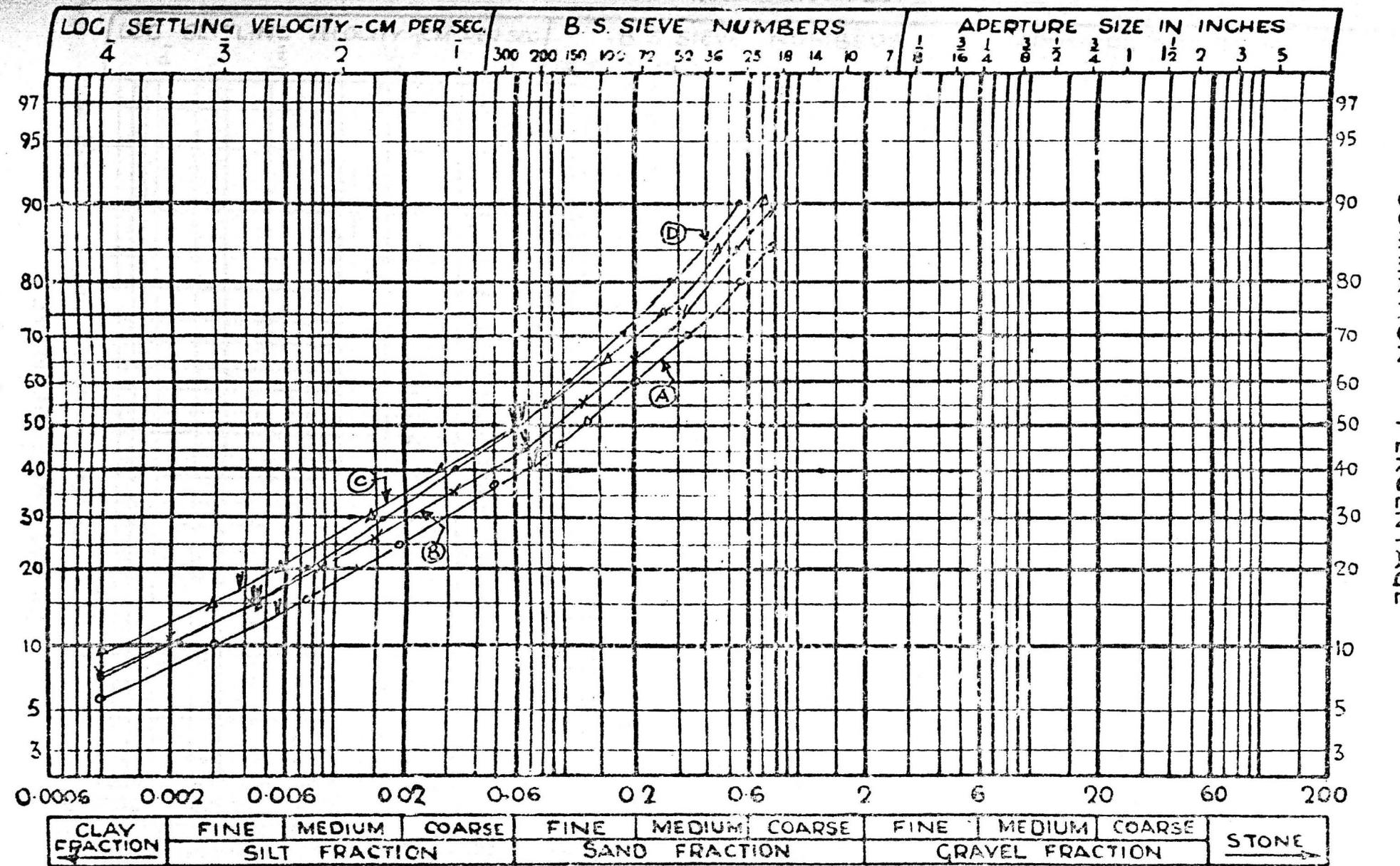


FIG. 5.155. LOG PROBABILITY PLOT OF KRUMBEIN'S ILLINOIS TILLS (A-D).

PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT

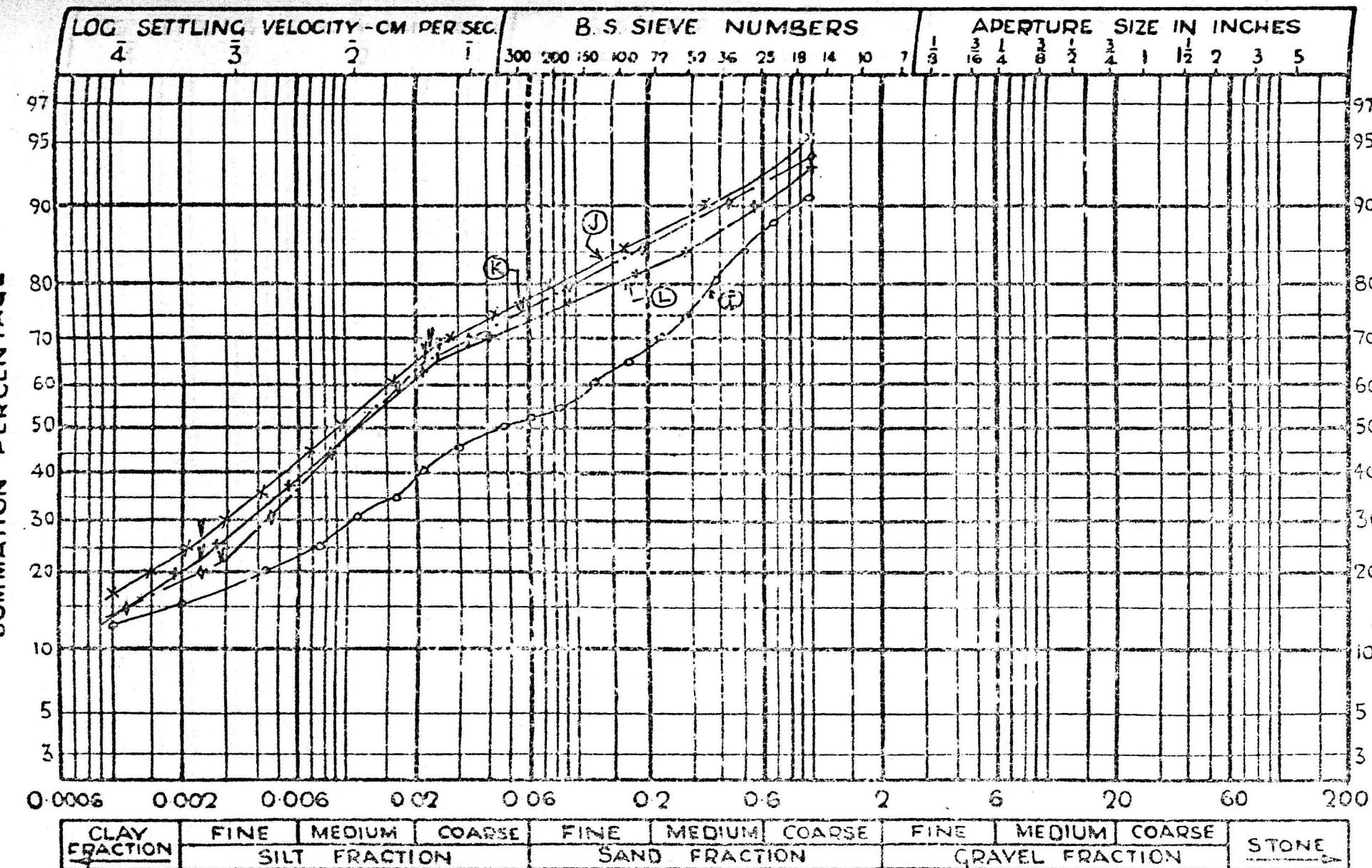


FIG. 5.157. LOG PROBABILITY PLOT OF KRUMBEIN'S ILLINOIS TILL (I-L).

PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT

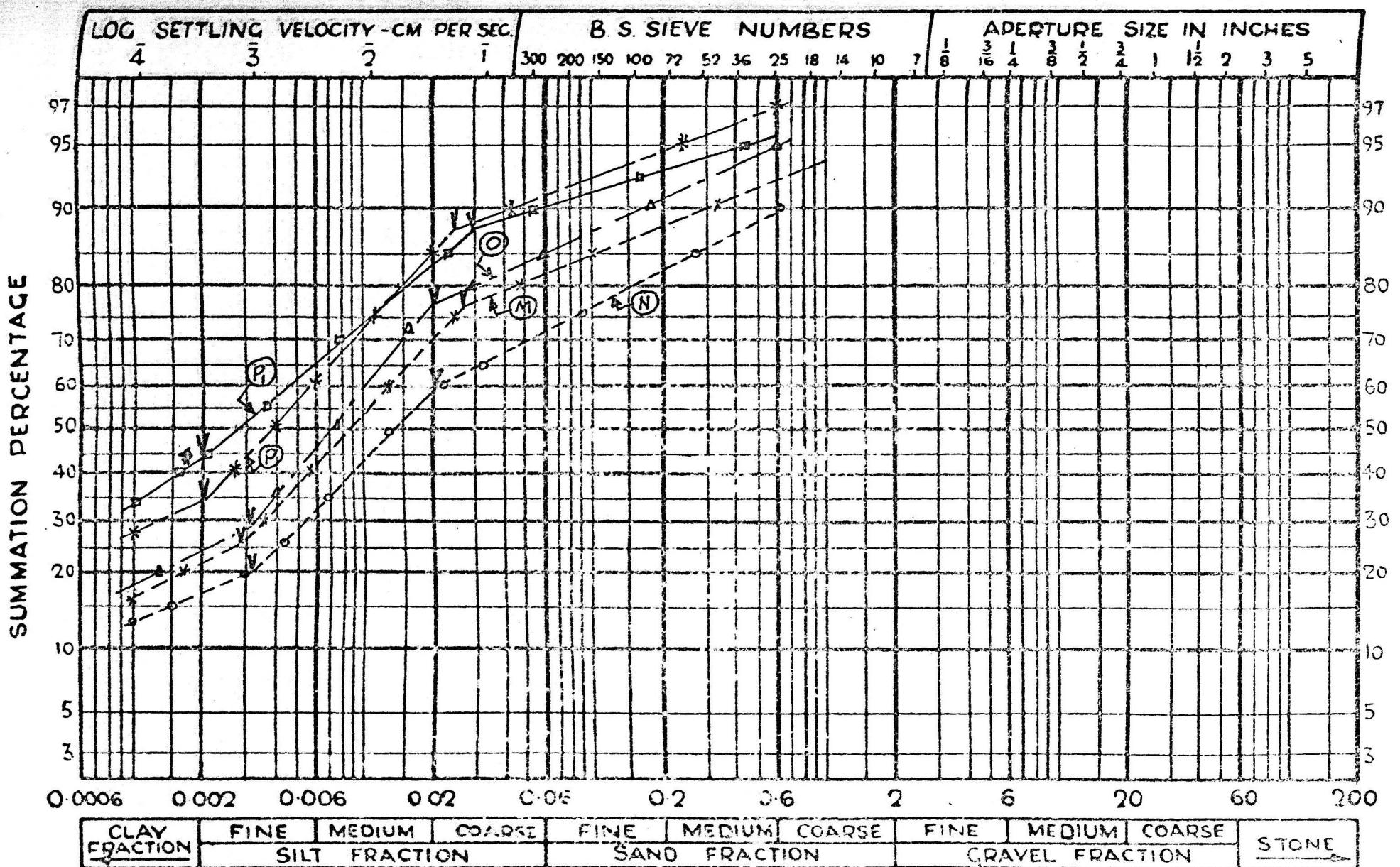


FIG. 5.158. LOG PROBABILITY PLOT OF KUMBEIN'S ILLINOIS TILLS (M-P).

**PARTICLE SIZE DISTRIBUTION  
LOG PROBABILITY PLOT**

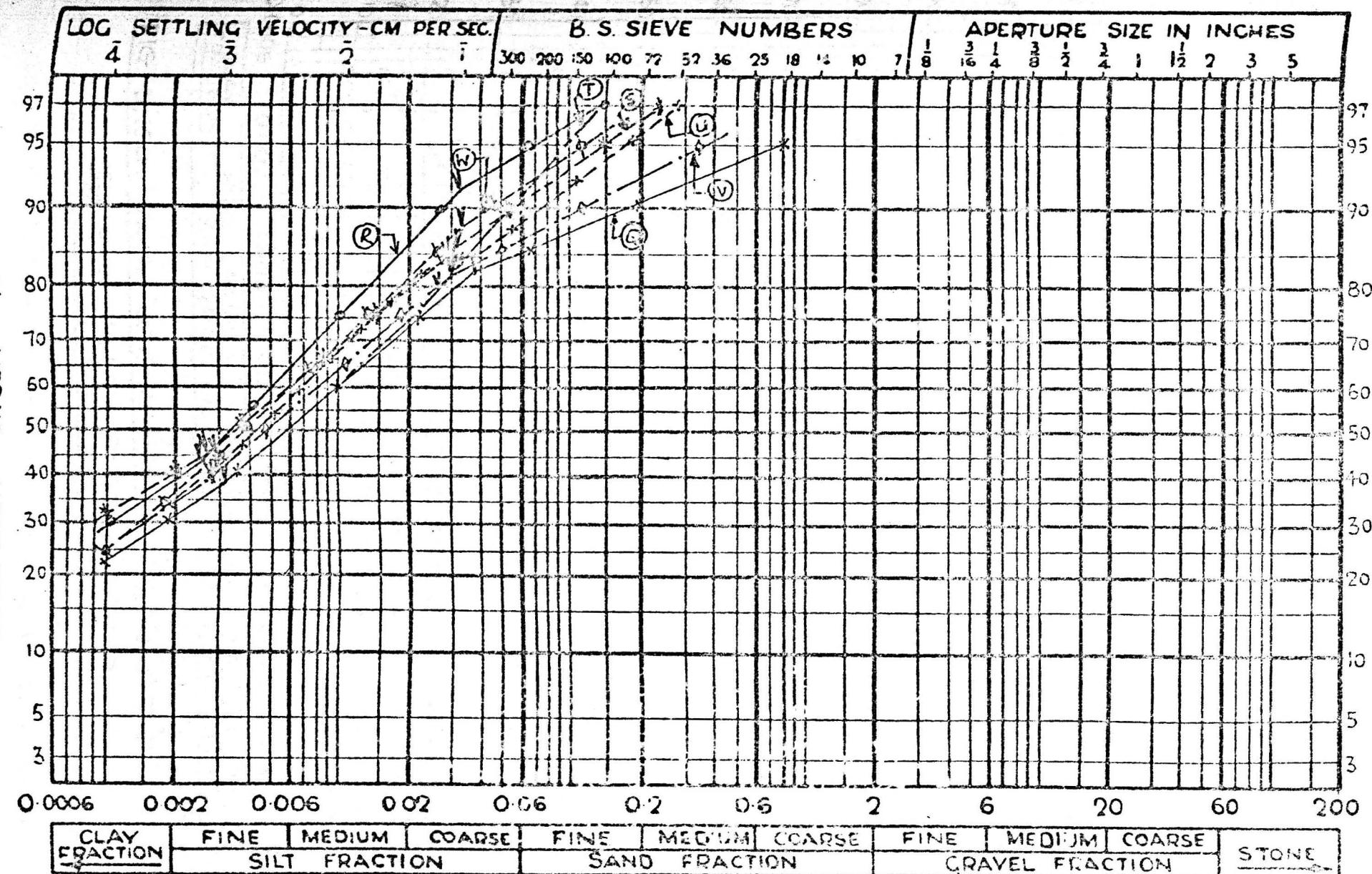


FIG. 5.159. LOG PROBABILITY PLOT OF KRUMBEIN'S ILLINOIS TILLS (Q-W).

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

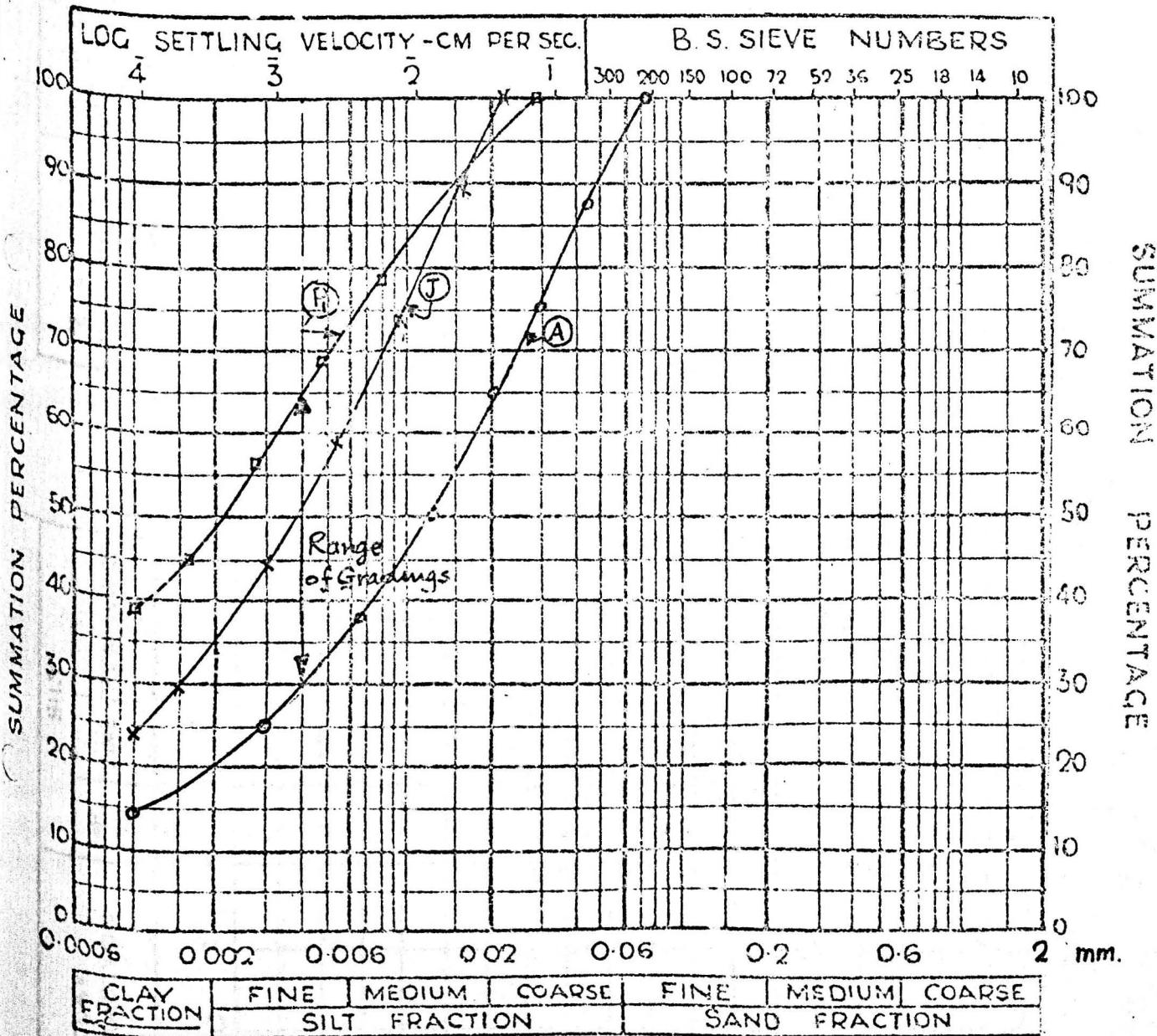


FIG. 5.160. RANGE OF GRADINGS FOR KRUMBEIN'S  
ILLINOIS TILLS - FINE FRACTIONS.

FOR KRUMBEIN'S ILLINOIS TILLS.(A-H).

FIG. 5.161. TEXTURAL CLASSIFICATION BASED ON  $\sigma_m$ .

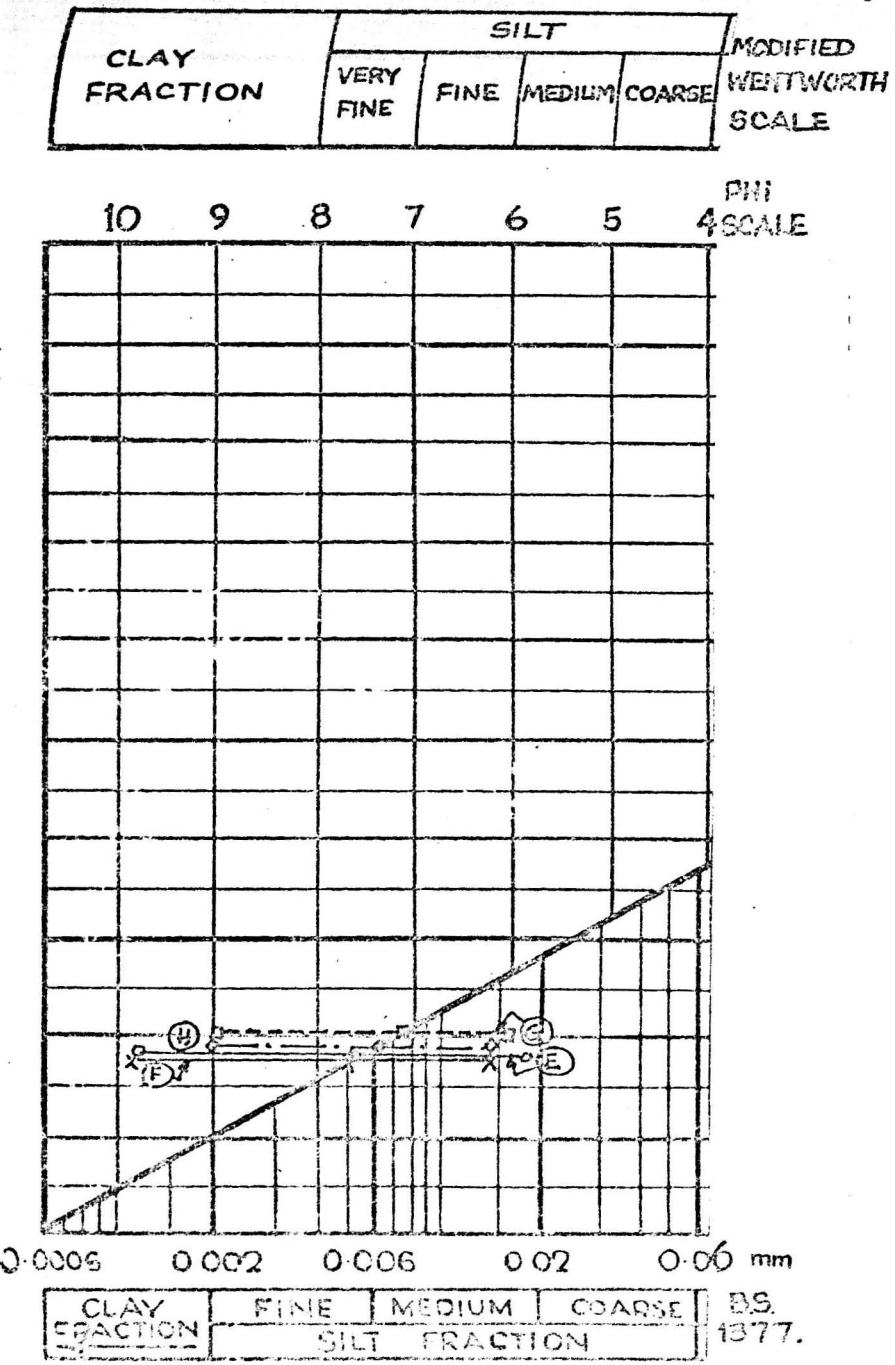
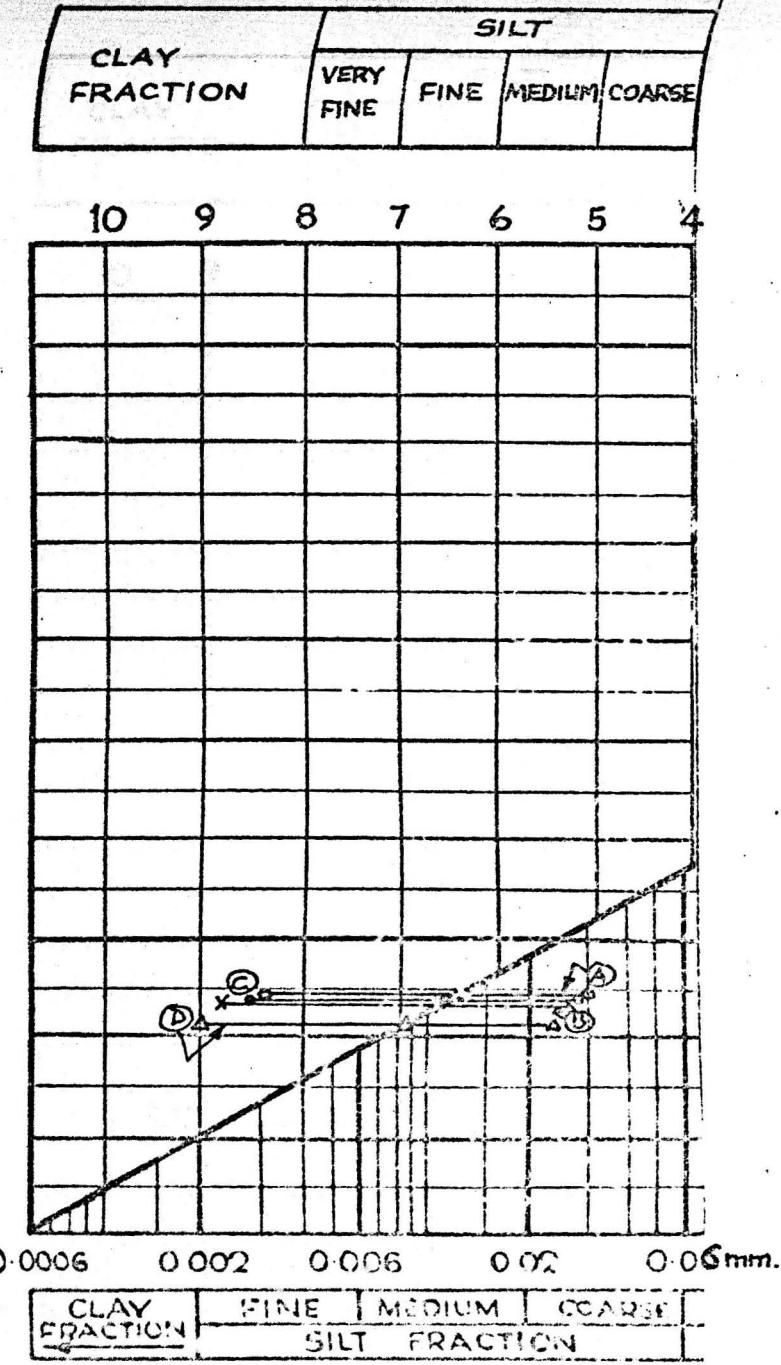
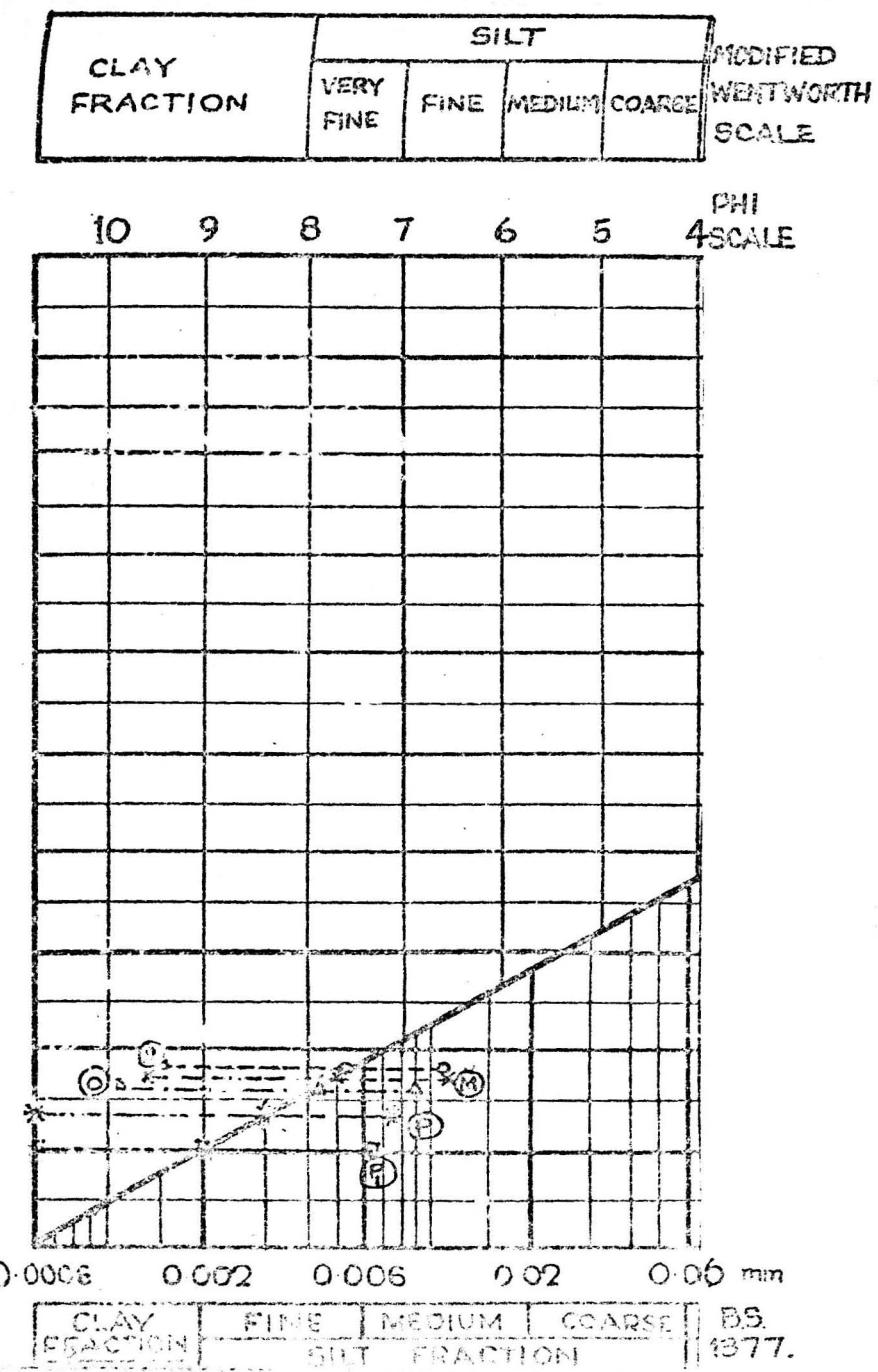
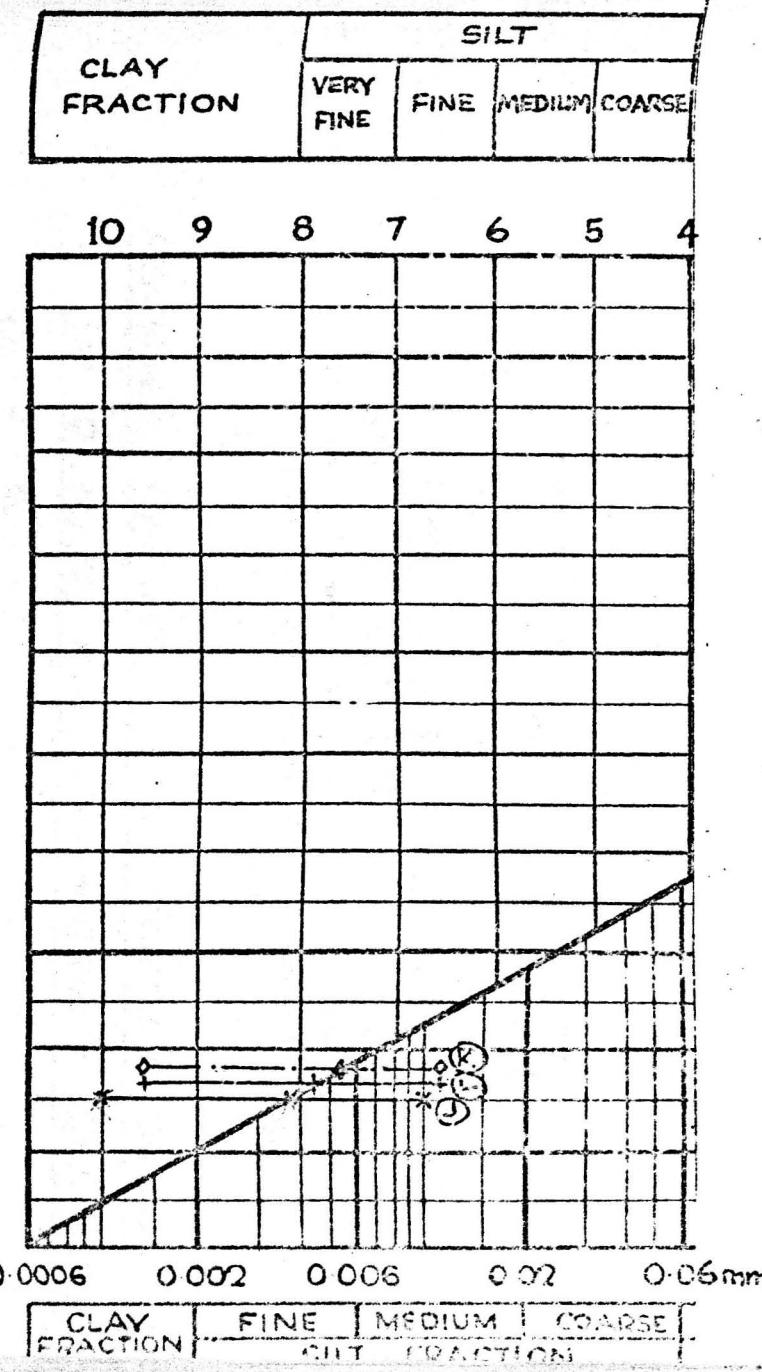


FIG. 5.162. TEXTURAL CLASSIFICATION BASED ON Q<sub>1</sub>, N<sub>2</sub>, D<sub>3</sub>,  
FOR KRUMBEIN'S ILLINOIS TILLS (J-R.).



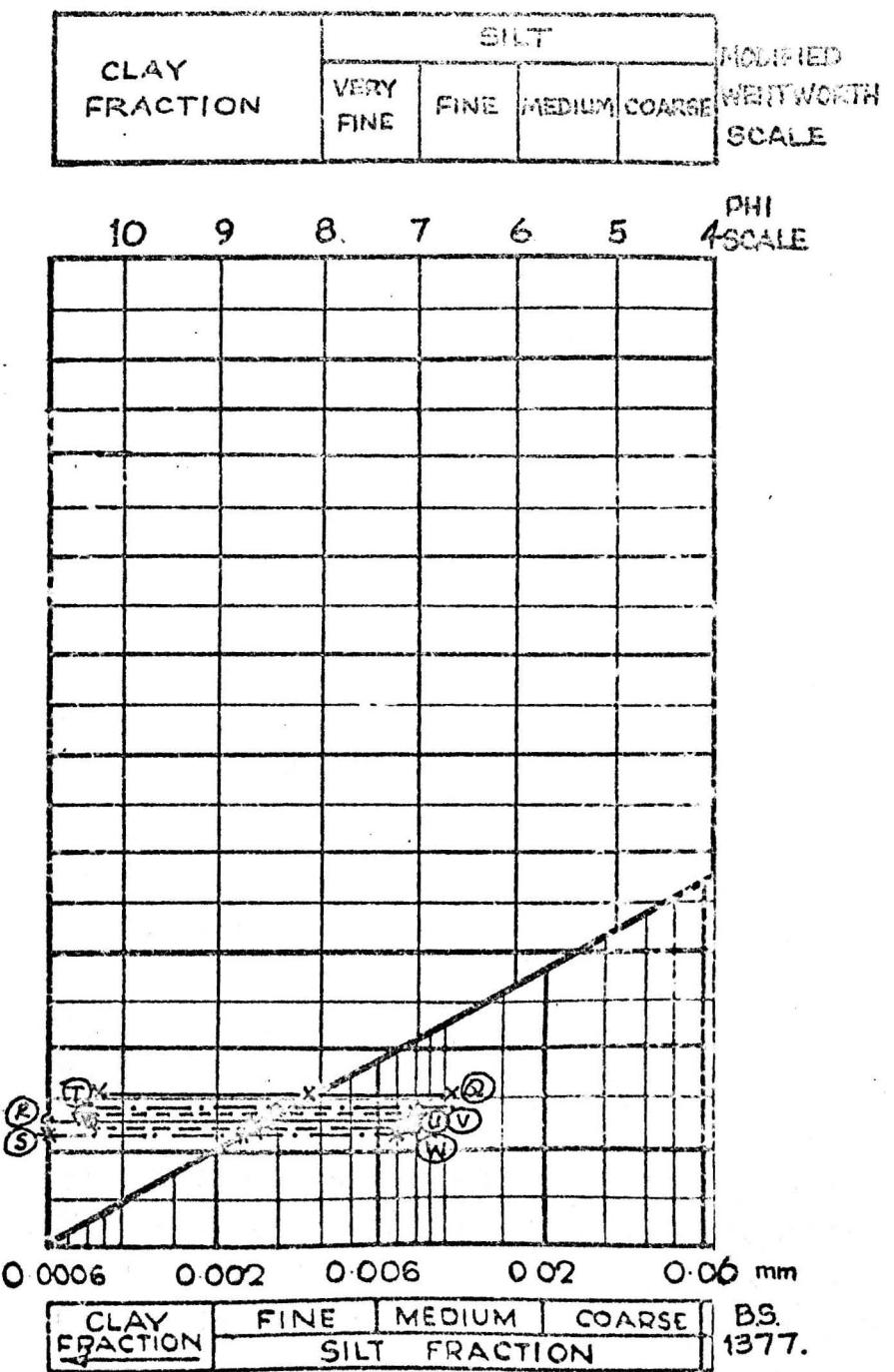


FIG. 5.163. TEXTURAL CLASSIFICATION BASED  
ON  $Q_1, M_1, Q_3$  FOR KRUMBEIN'S ILLINOIS  
TILLS (Q-W).

FIG. 5.164. LITHOLOGIC VARIATIONS IN ILLINOIS TILL (AFTER KRUMBEIN, 1953).

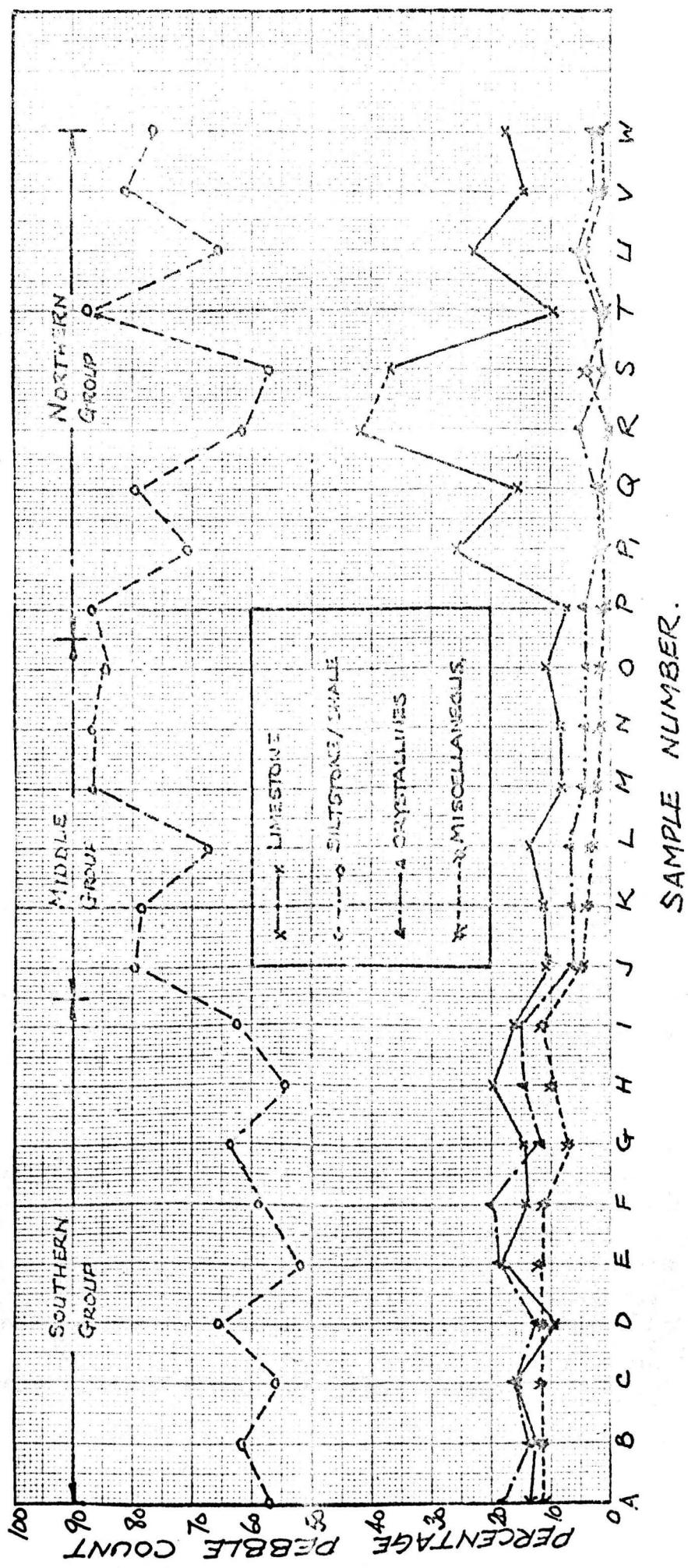


FIG. 5. 165. VARIATION IN GRAIN SIZE INDICES AND FINES CONTENT  
IN KRAMBEIN'S ILLINOIS TILLS.

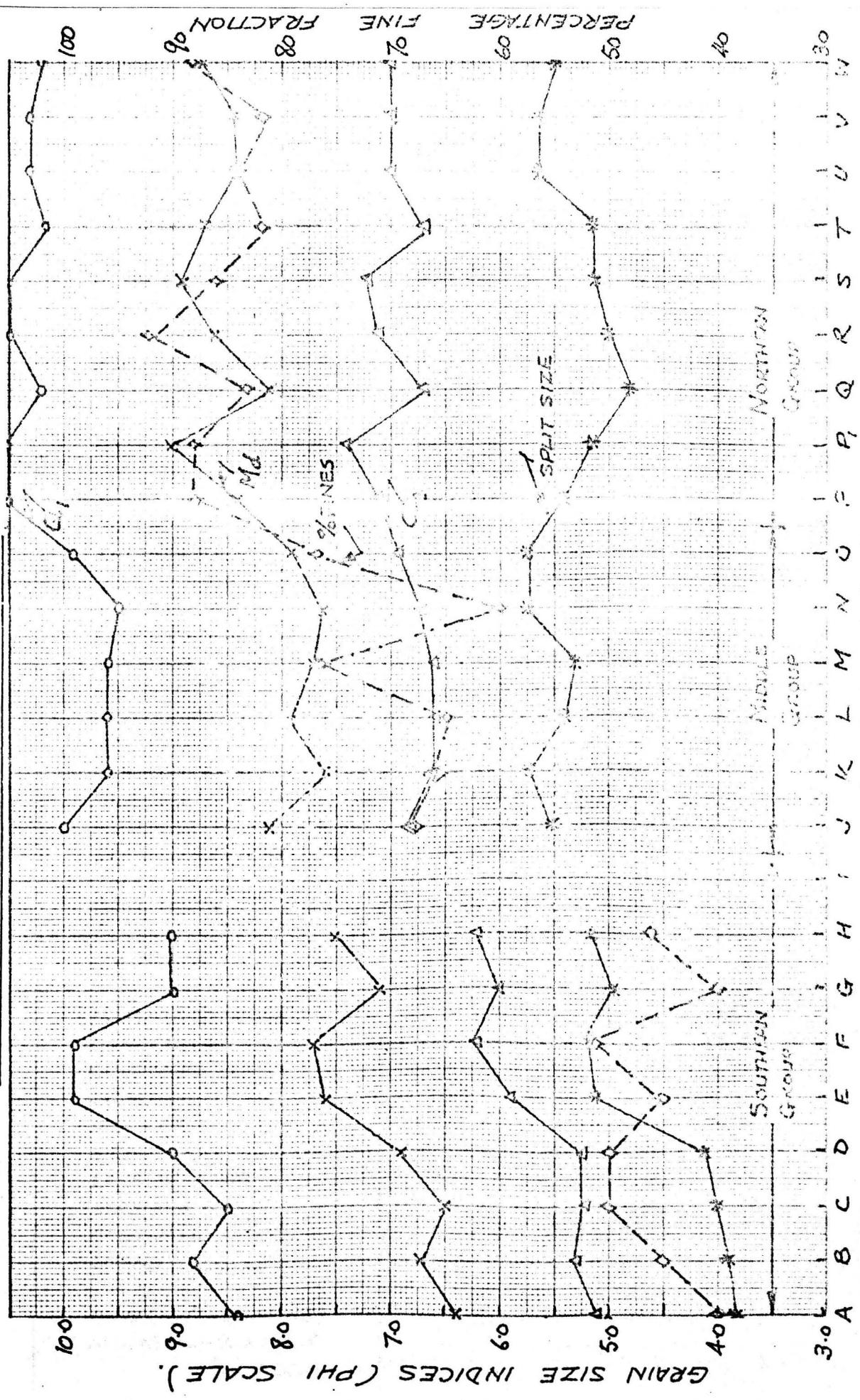


FIG. 5.166. VARIATION IN UPPER SPLIT SIZES IN ALL TILLS.

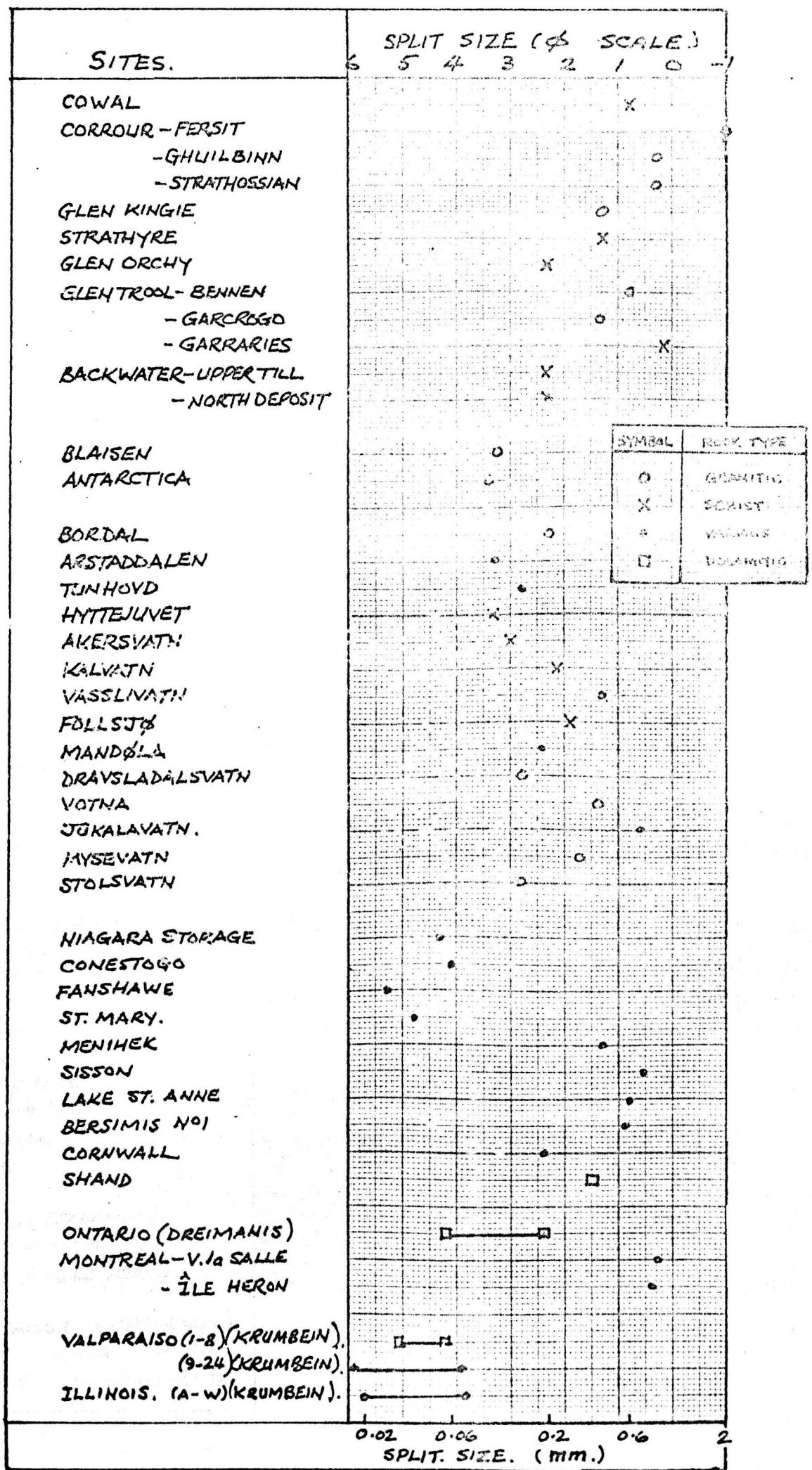


FIG. 5.167. VARIATION IN PERCENTAGE FINES IN ALL TILLS.

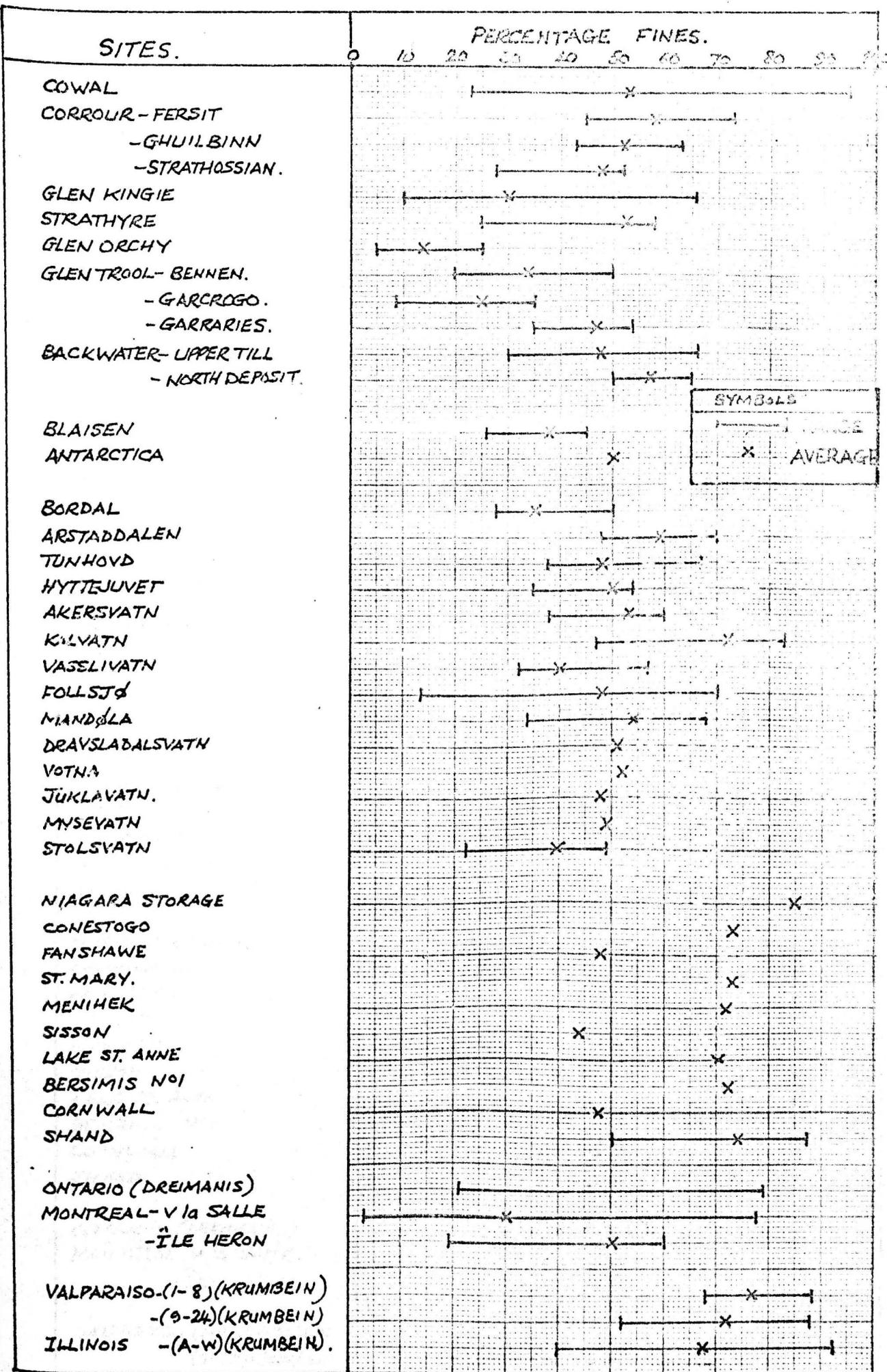
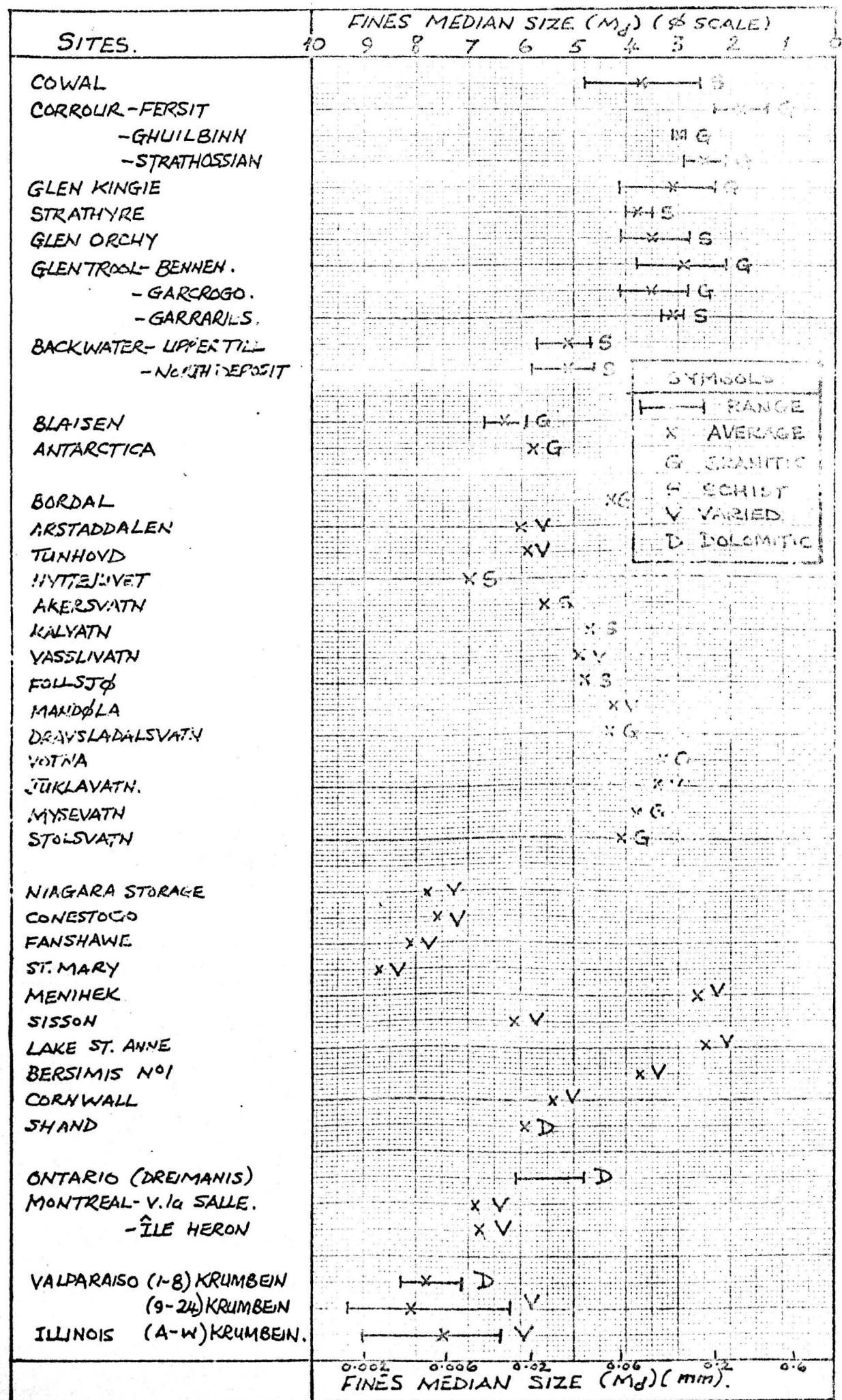
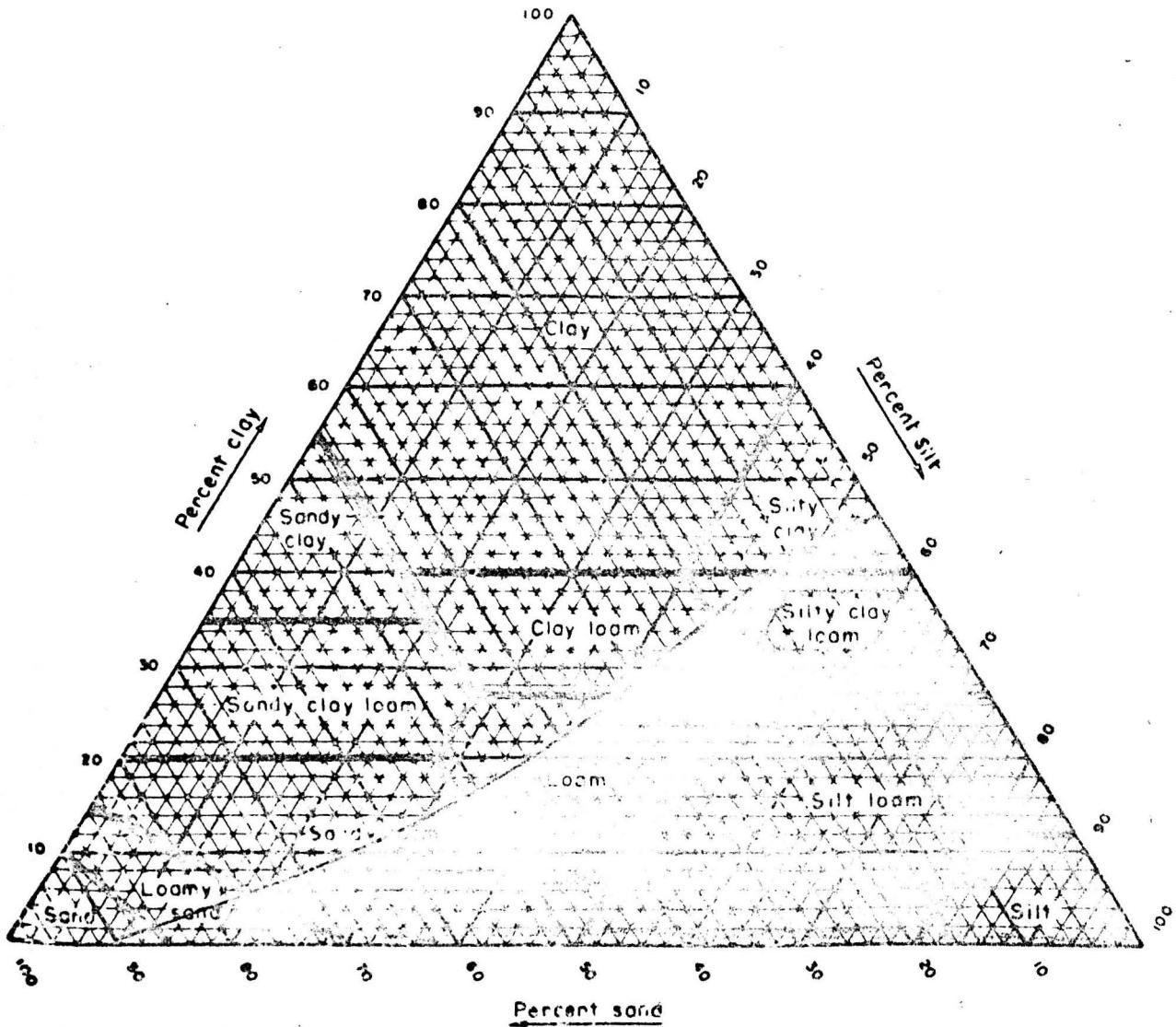


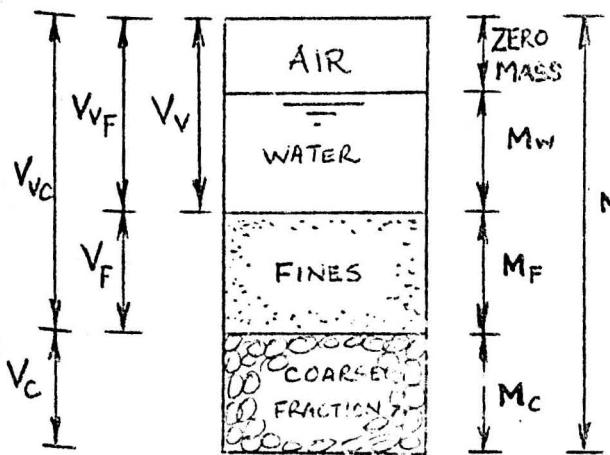
FIG. 5.168. MEDIAN GRAIN SIZE INDICES IN ALL TILLS.





PERCENTAGES OF CLAY (BELOW 0.002 mm.),  
SILT (0.002 TO 0.05 mm.), AND SAND (0.05 TO 2.0 mm.)  
IN THE BASIC SOIL TEXTURAL CLASSES

FIG. 5.169. TRIANGULAR DIAGRAM FOR ALL TILLS.



$V_s$  = Total volume of composite soil  
 $V_c$  = Absolute volume of coarse fraction  
 $V_F$  = Absolute volume of fine fraction  
 $V_v$  = Absolute volume of voids in composite soil  
 $V_{vc}$  = Volume of voids within coarse fraction  
 $= (V_F + V_v)$

$V_{vF}$  = Volume of voids within fine fraction  
 $= (V_{vc} - V_F) = V_v$   
 $M_s$  = Mass of composite soil  
 $M_c$  = Mass of coarse fraction  
 $M_F$  = Mass of fine fraction  
 $M_w$  = Mass of water

Note Suffixes:- S denotes the composite soil

C " " coarse fraction  
 F " " fine fraction.

FIG. 6.1. MODEL OF COMPOSITE SOIL.

FIG. 6.2. MINIMUM POSSIBLE VOIDS IN SEDS OF TWO COMPOSITE SIZES (AFTER FURNAS, 1931).

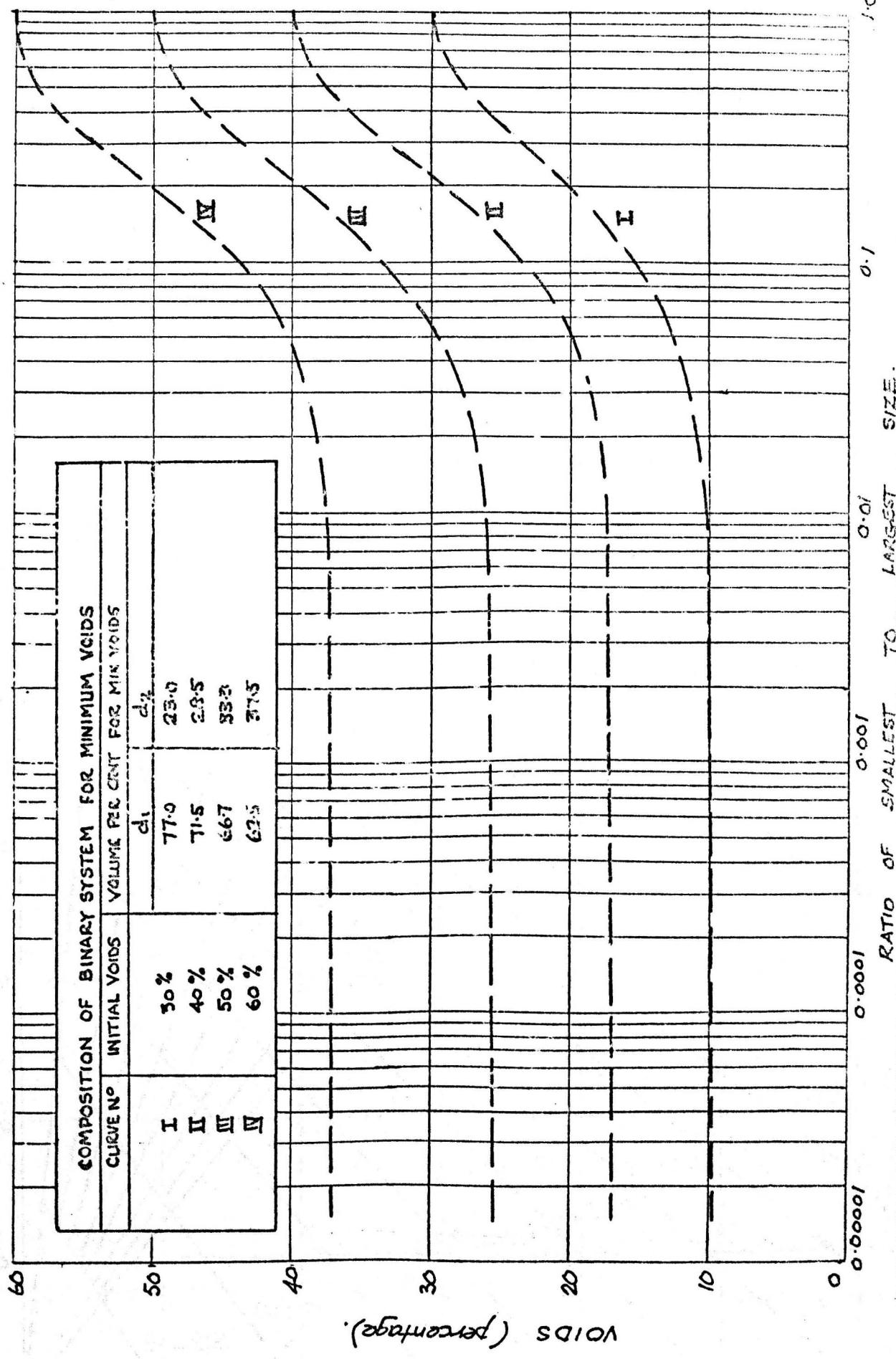
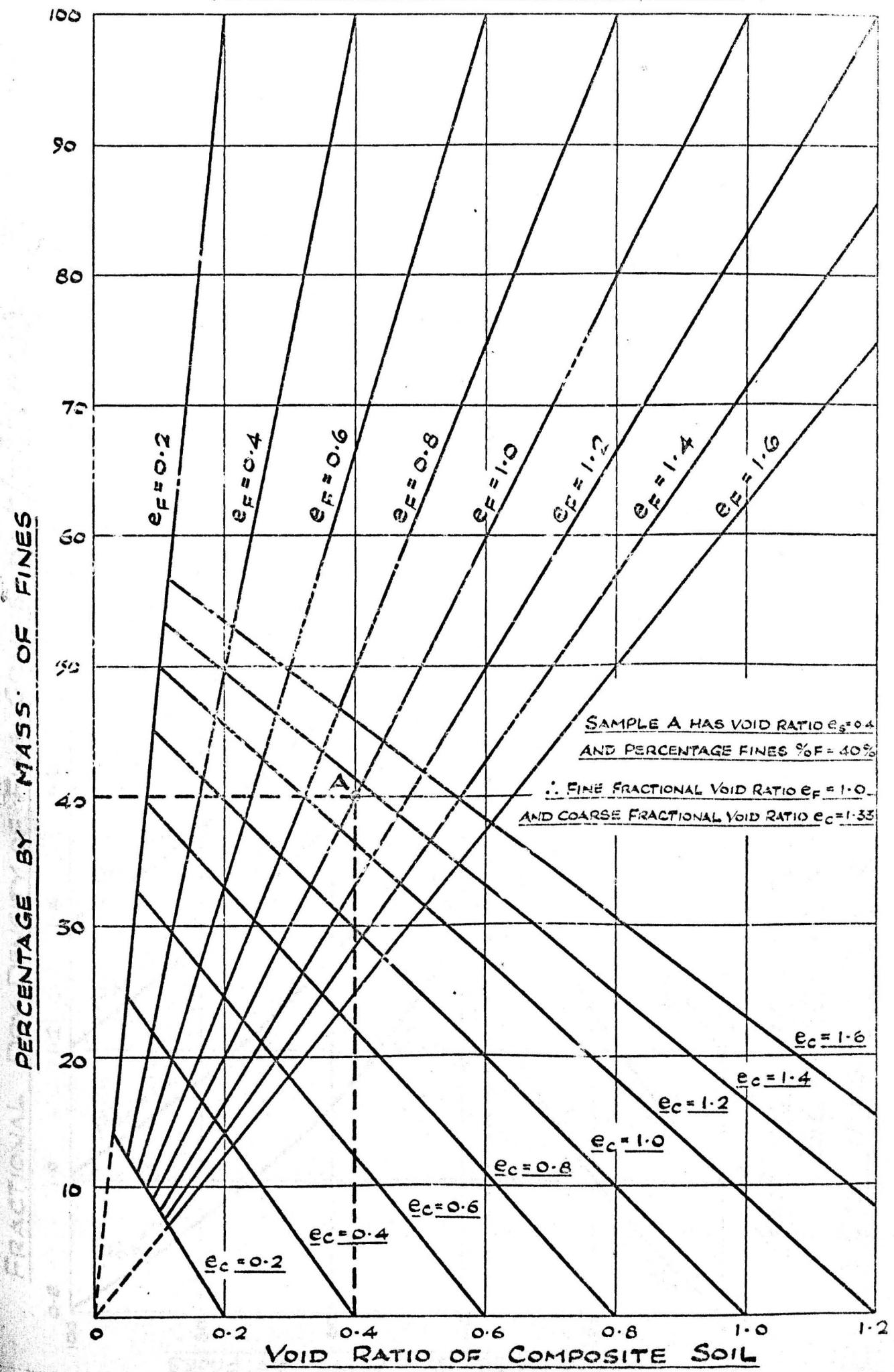


FIG. 6.3. FRACTIONAL VOID RATIO - PERCENTAGE FINES  
(FOR UNIFORM SPECIFIC GRAVITY)



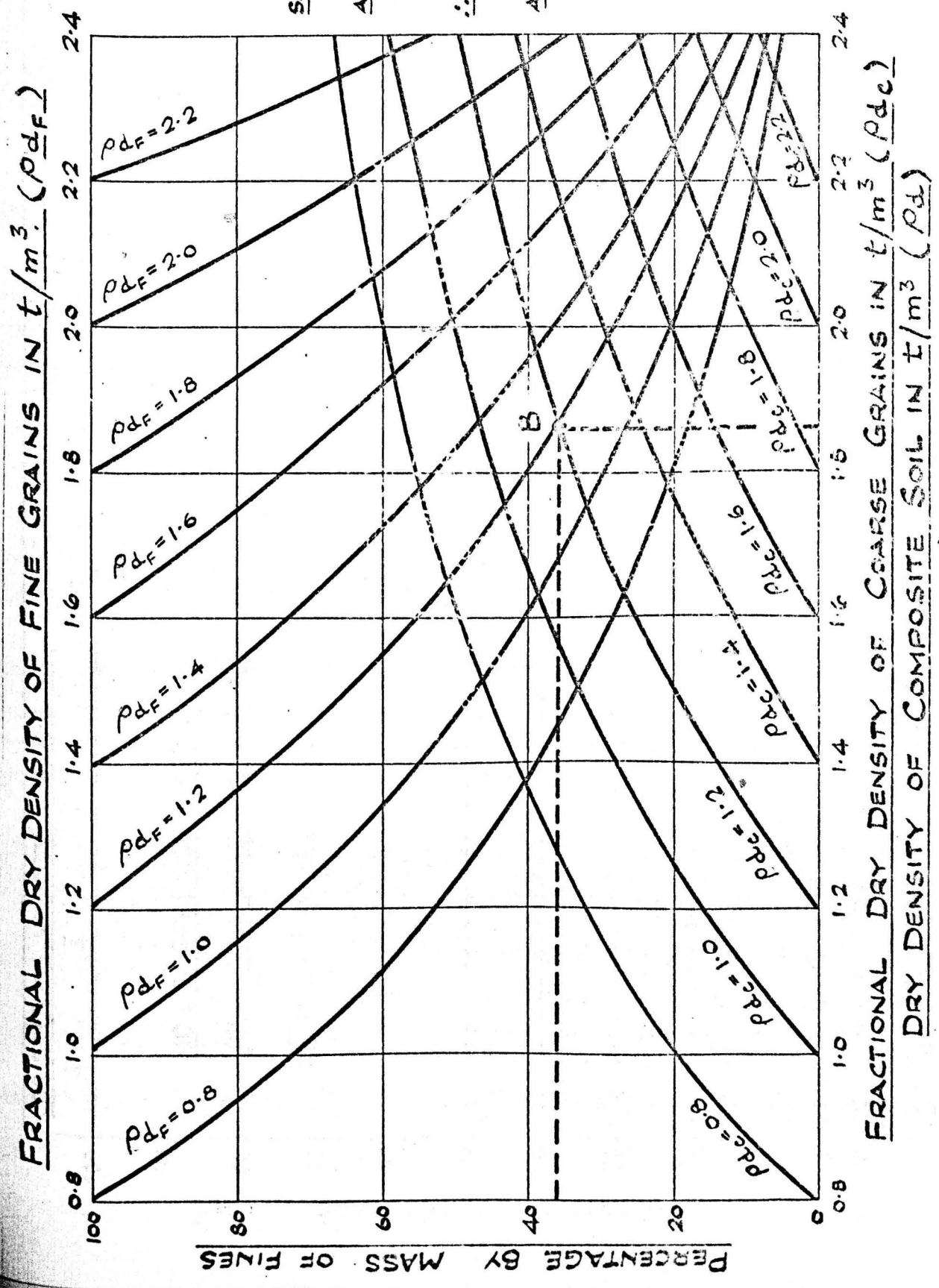
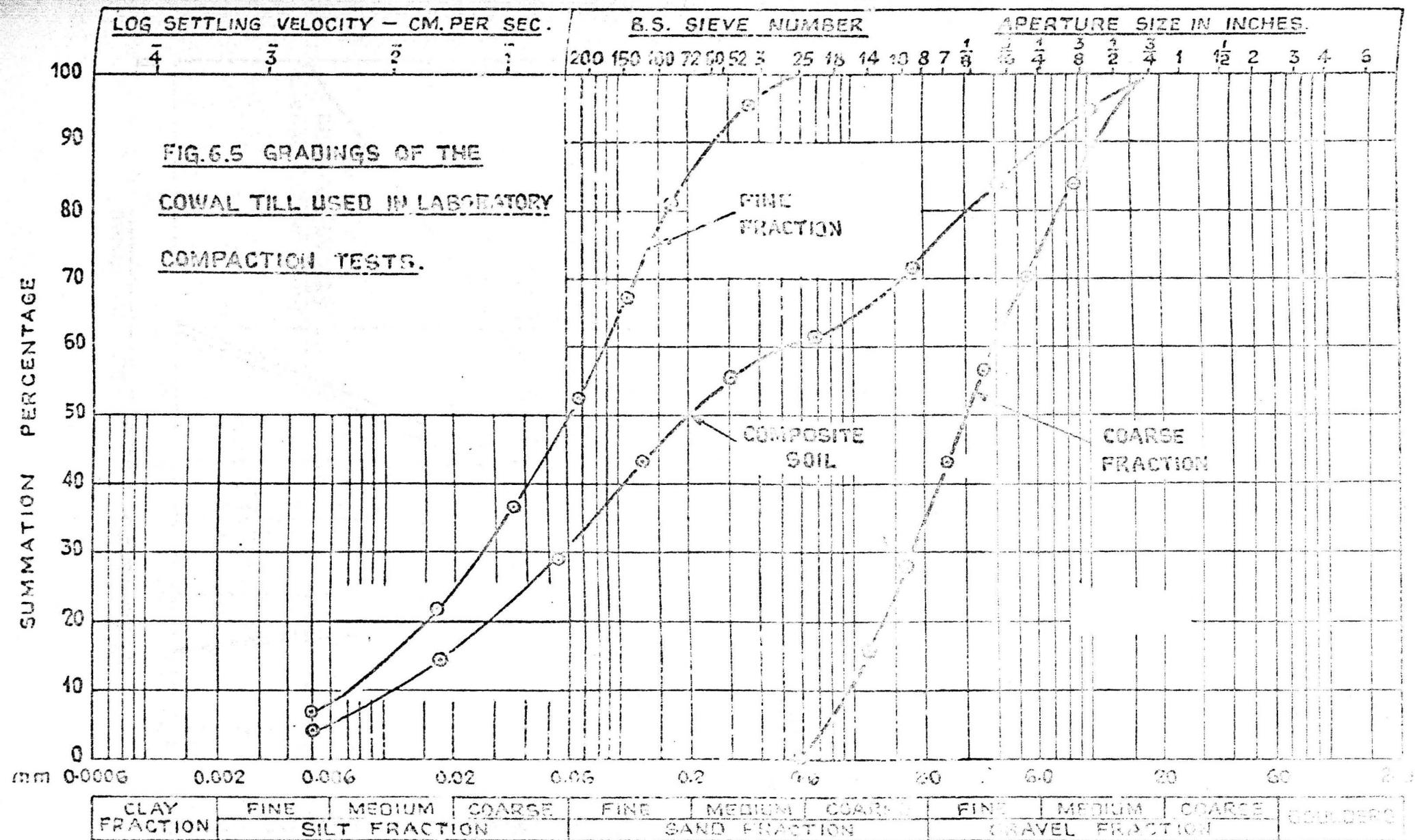


FIG. 6.4 DRY DENSITY PERCENTAGE FINES - MASTER CURVES FOR UNIFORM S.G. = 2.68.



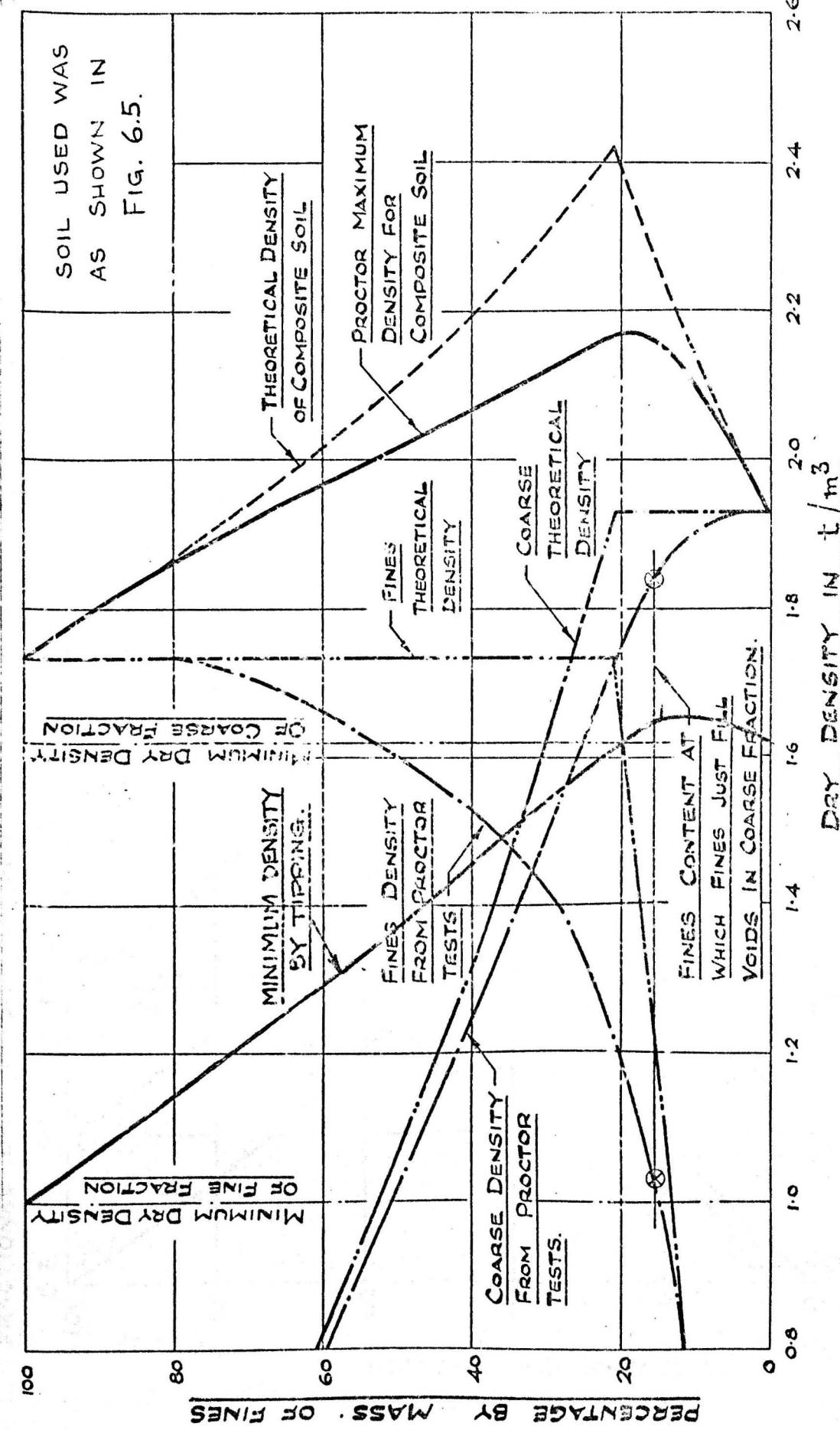


FIG.6.6. VARIATION IN MAXIMUM DRY DENSITY OF A COMPOSITE SOIL FROM STANDARD PROCTOR TESTS AND TIPPING.

( NOTE : Soil used was as shown in FIG.6.5 )

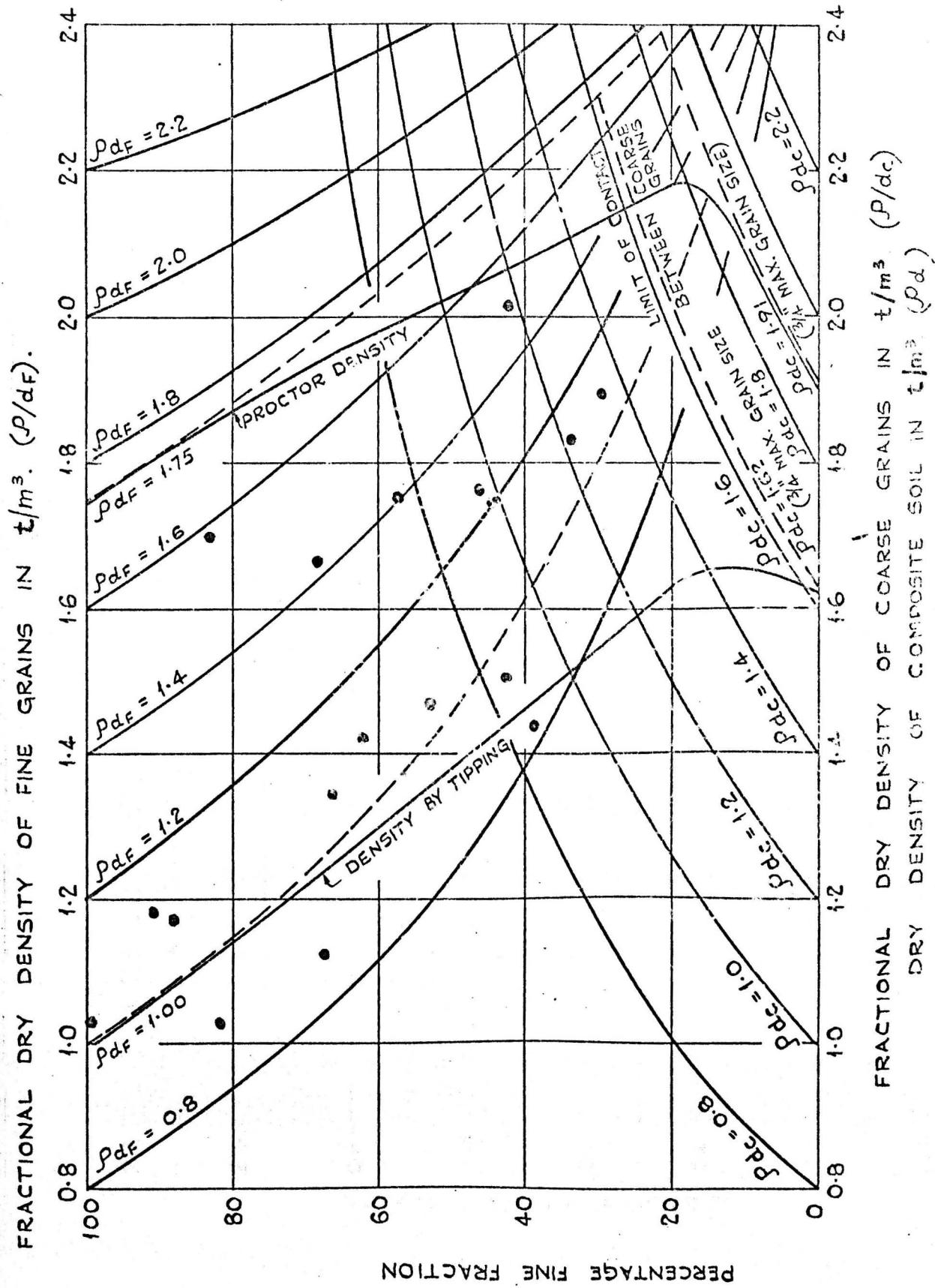


FIG. E-7. PLOT OF FIELD DENSITY MEASUREMENTS FOR BROWN COAL TILLS

FIG. 6.8. IN-SITU DENSITY OF CENTRAL

BREIDAMERKURJOKULL TILLS.

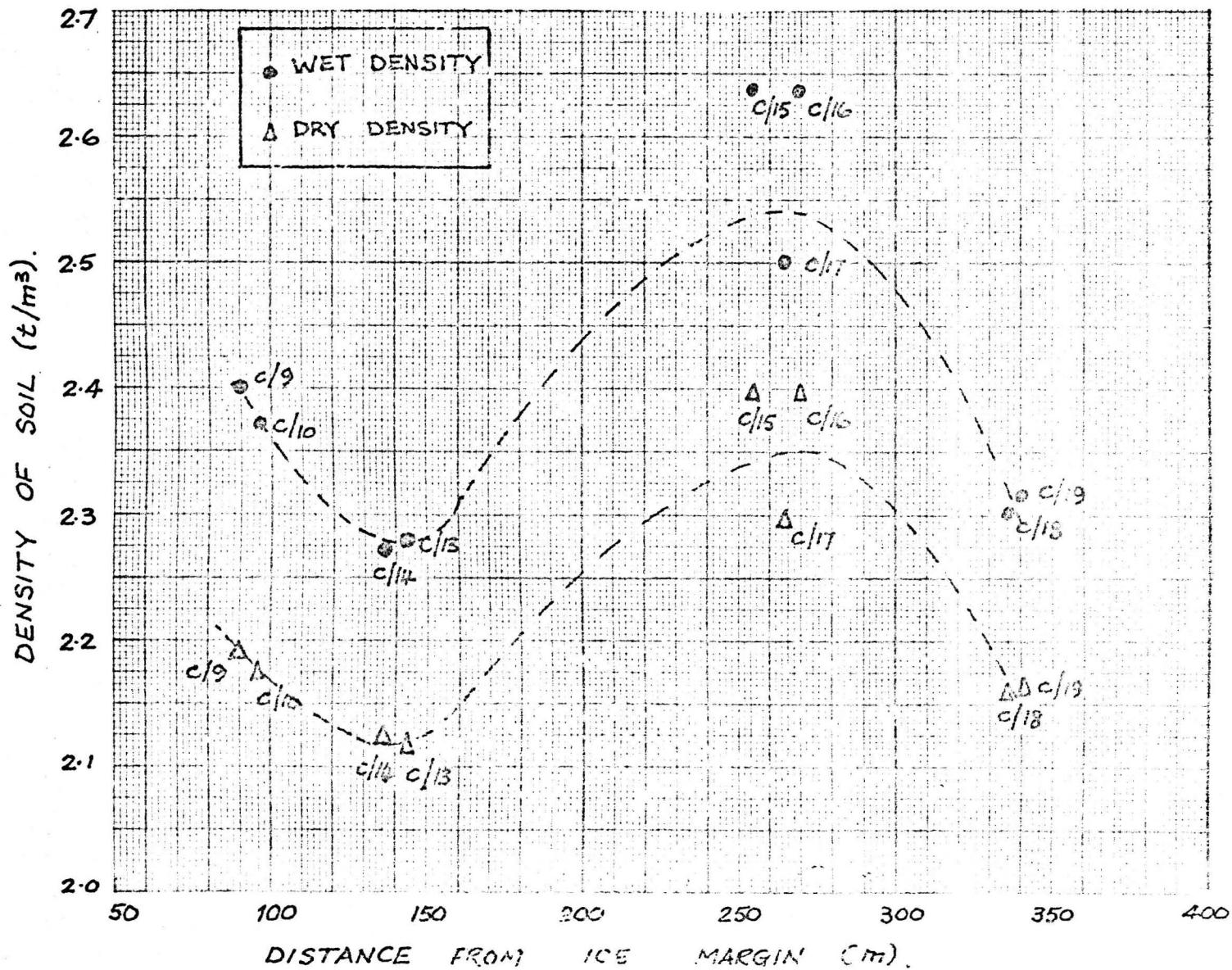
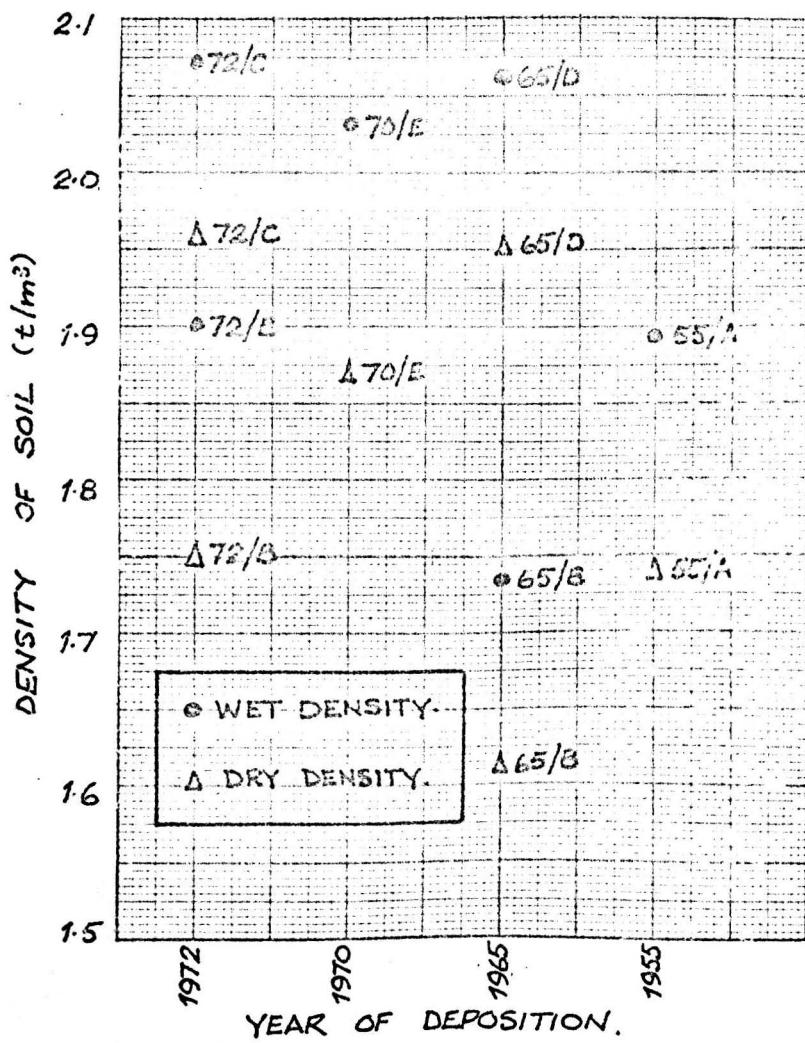


FIG. 6.9. IN-SITU DENSITY OF  
BLAISEN TILLS.



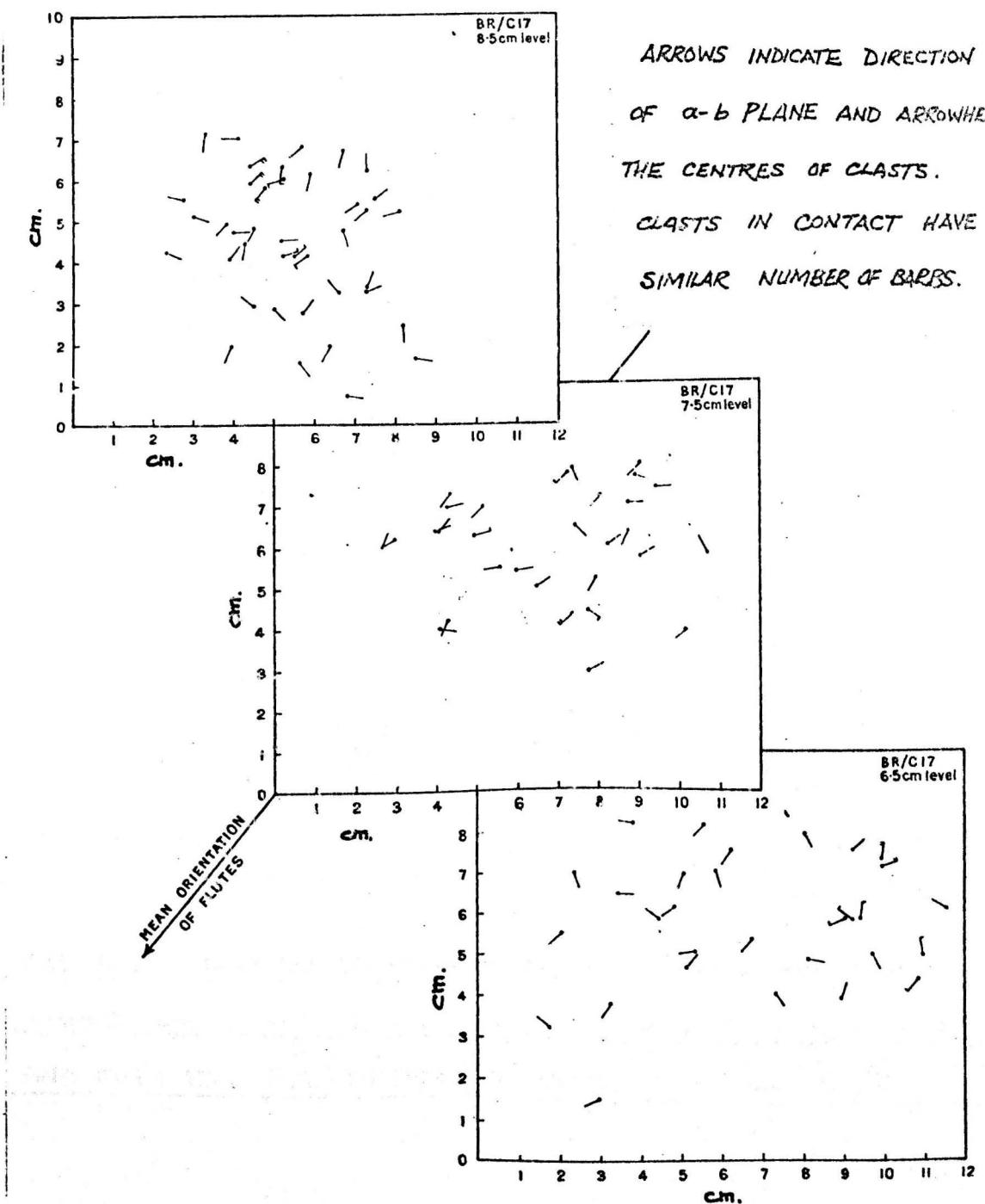


FIG. 6.10 . TIERED DIAGRAM EXPRESSING THE LOCATION AND DIP OF a-b PLANES OF CLASTS AT THREE LEVELS WITHIN BREIDA MERKURJO KULL SAMPLE BR/C17.

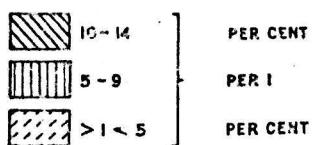
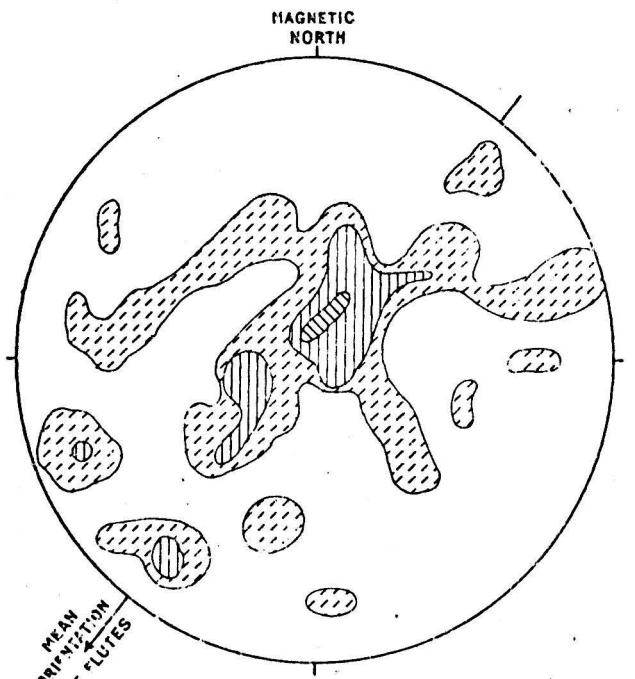


FIG. 6.11. CONTOURED SCHMIDT NET EXPRESSING CLAST FABRIC DATA FOR 8.5 cm. LEVEL SHOWN IN PLATE 6.3 AND FIG. 6.10, FOR BREIDAMERKURJOKULL TILL BR/C 17.

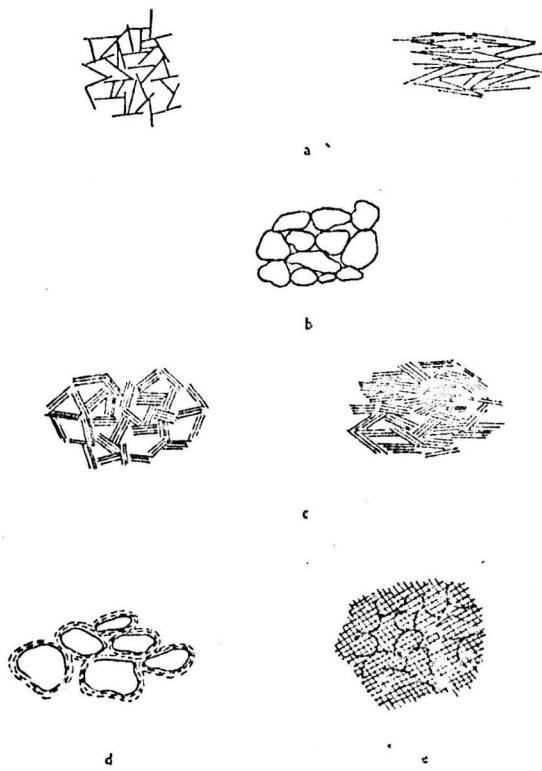


FIG. 6.12. SCHEMATIC REPRESENTATION OF ELEMENTARY PARTICLE ARRANGEMENTS.

- (a) INDIVIDUAL CLAY PLATELET INTERACTION;
- (b) INDIVIDUAL SILT OR SAND PARTICLE INTERACTION;
- (c) CLAY PLATELET GROUP INTERACTION;
- (d) CLOTHED SILT OR SAND PARTICLE INTERACTION;
- (e) PARTLY DISCERNIBLE PARTICLE INTERACTION.

(COLLINS AND MCGOWN, 1974.)

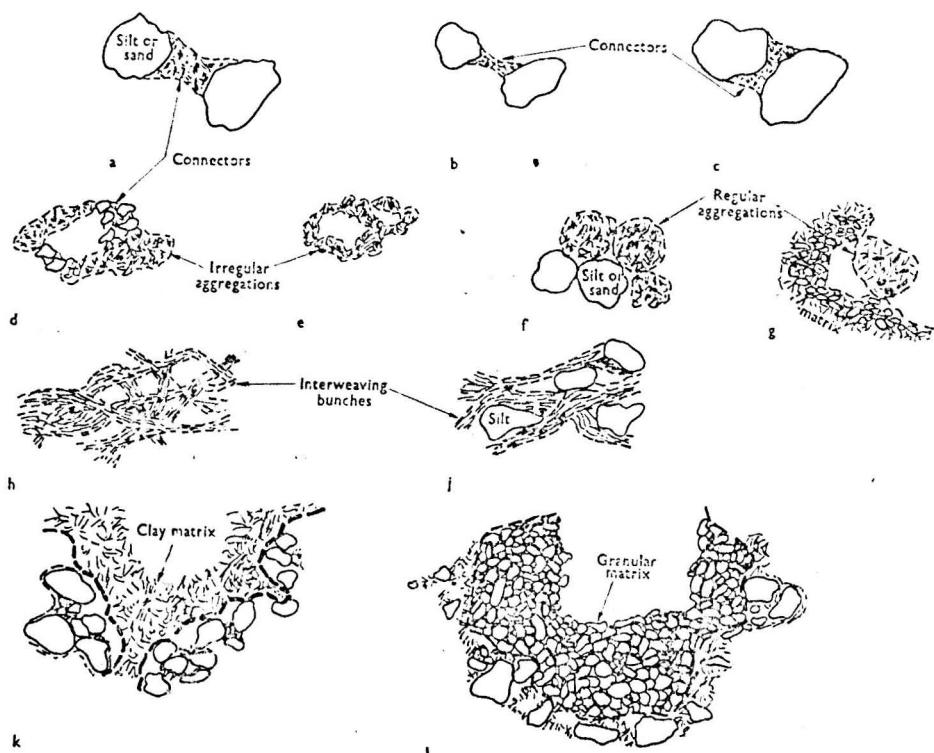


FIG. 6.13. SCHEMATIC REPRESENTATION OF  
PARTICLE ASSEMBLAGES.

(a), (b), (c) CONNECTORS; (d) IRREGULAR AGGREGATIONS.  
LINKED BY CONNECTORS; (e) IRREGULAR  
AGGREGATION FORMING A HONEYCOMB ARRANGEMENT;  
(f) REGULAR AGGREGATIONS INTERACTING WITH  
SILT OR SAND GRAINS; (g) REGULAR AGGREGATIONS  
INTERACTING WITH PARTICLE MATRIX; (h) INTERWEAVING  
BUNCHES OF CLAY; (i) INTERWEAVING BUNCHES OF CLAY  
WITH SILT INCLUSIONS; (j) CLAY PARTICLE MATRIX;  
(l) GRANULAR PARTICLE MATRIX. (COLLINS AND MCGOWN 1974).

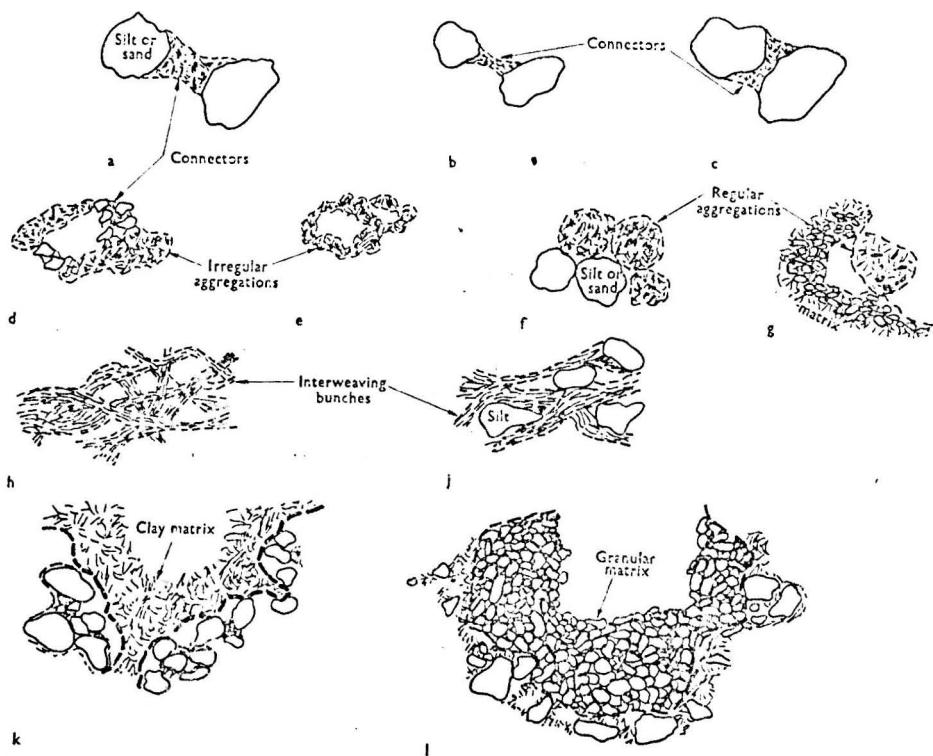


FIG. 6.13. SCHEMATIC REPRESENTATION OF  
PARTICLE ASSEMBLAGES.

(a), (b), (c) CONNECTORS; (d) IRREGULAR AGGREGATIONS.  
LINKED BY CONNECTORS; (e) IRREGULAR  
AGGREGATION FORMING A HONEYCOMB ARRANGEMENT;  
(f) REGULAR AGGREGATIONS INTERACTING WITH  
SILT OR SAND GRAINS; (g) REGULAR AGGREGATIONS  
INTERACTING WITH PARTICLE MATRIX; (h) INTERWEAVING  
BUNCHES OF CLAY; (i) INTERWEAVING BUNCHES OF CLAY  
WITH SILT INCLUSIONS; (j) CLAY PARTICLE MATRIX;  
(l) GRANULAR PARTICLE MATRIX. (COLLINS AND MCGOWAN 1974).

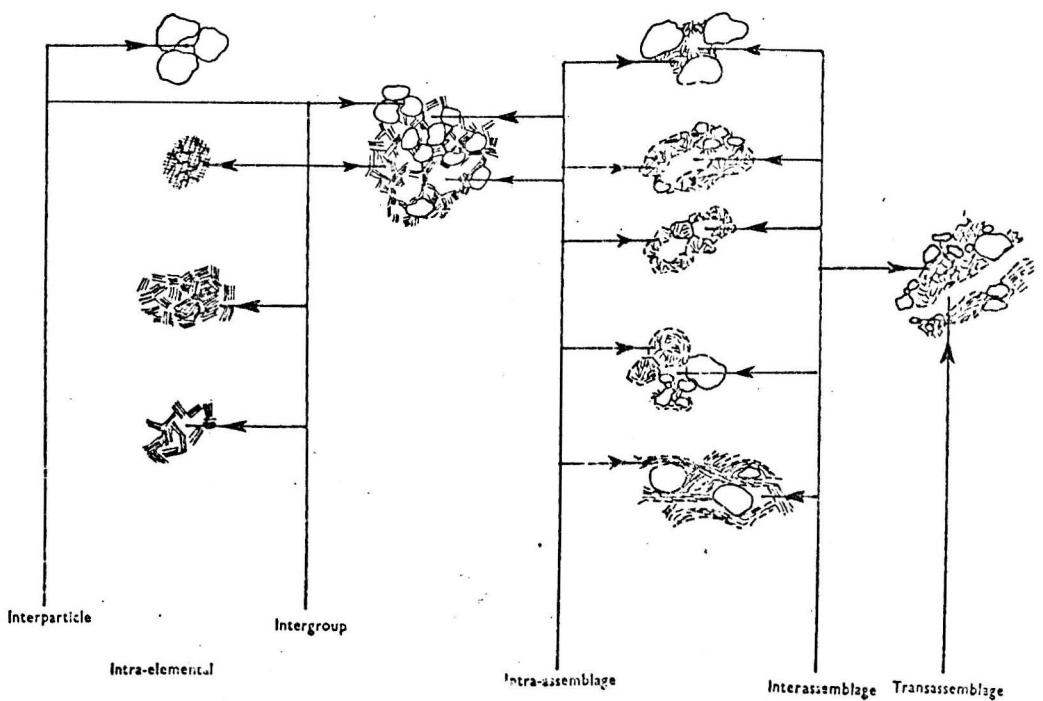
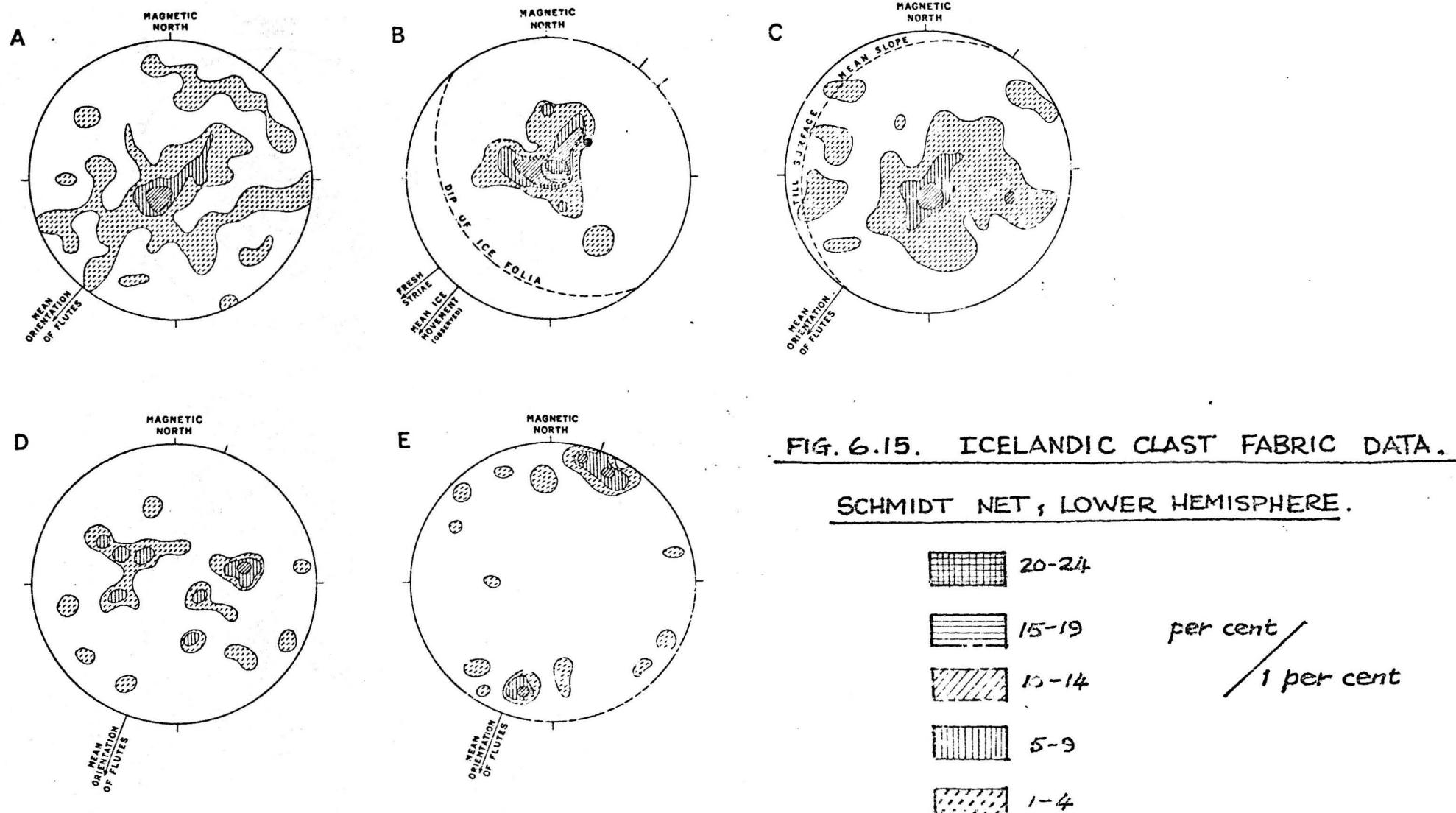


FIG. 6.14. SCHEMATIC REPRESENTATION OF  
PORE SPACE TYPES. (COLLINS and MCGOWAN 1974)



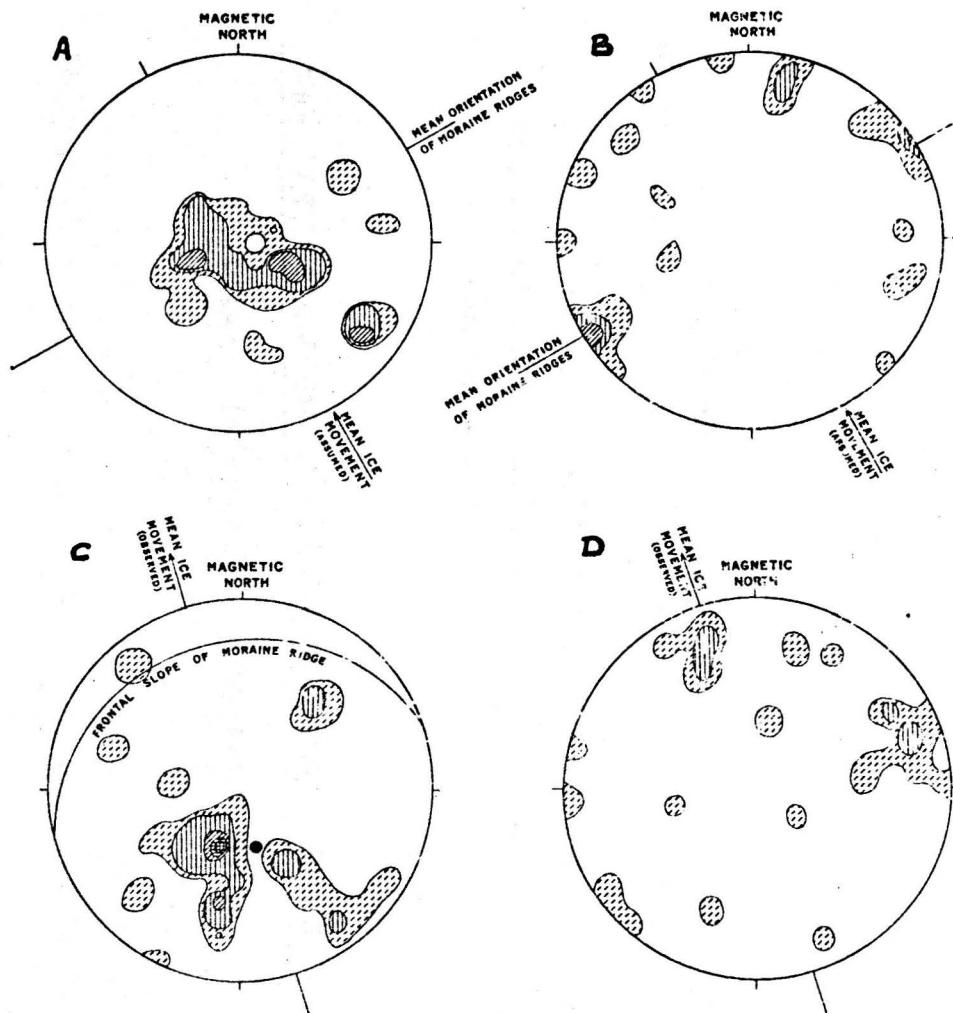
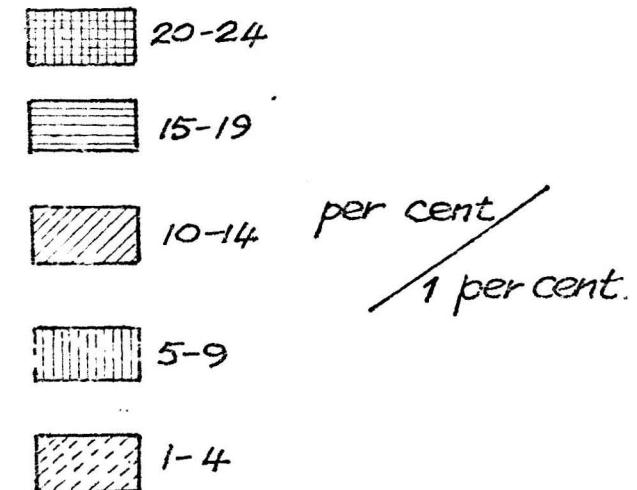


FIG. 6.16 NORWEGIAN CLAST FABRIC DATA

SCHMIDT NET, LOWER HEMISPHERE



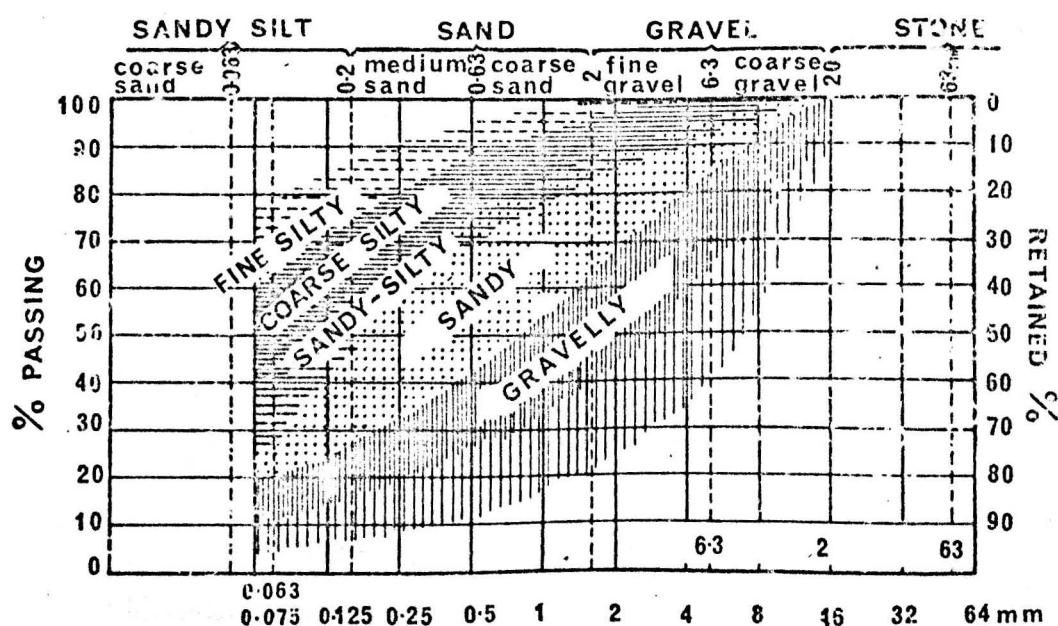
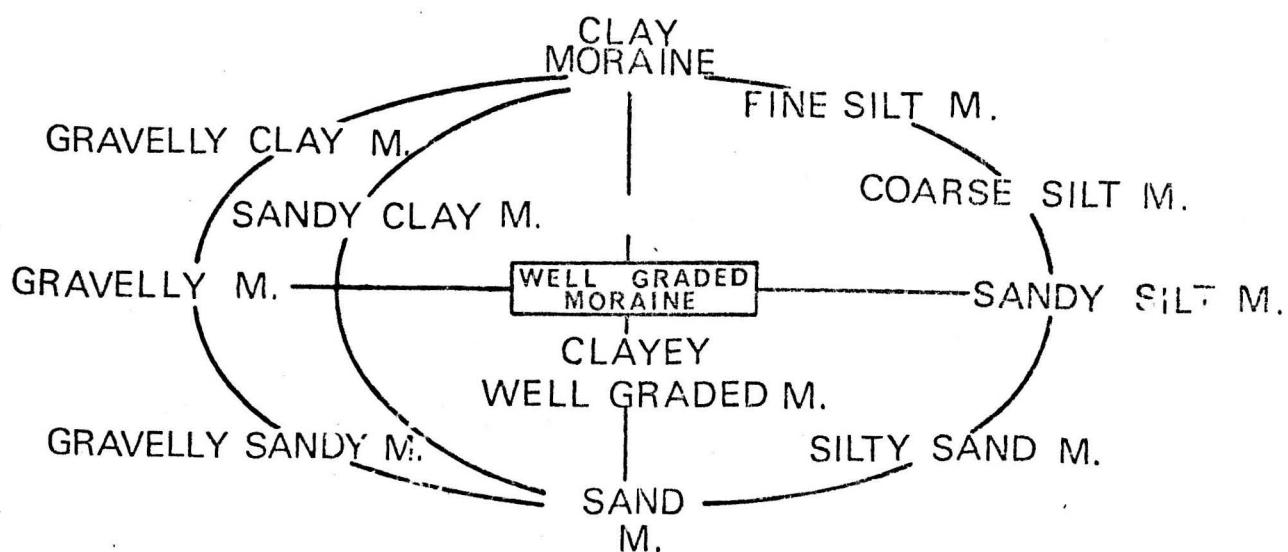
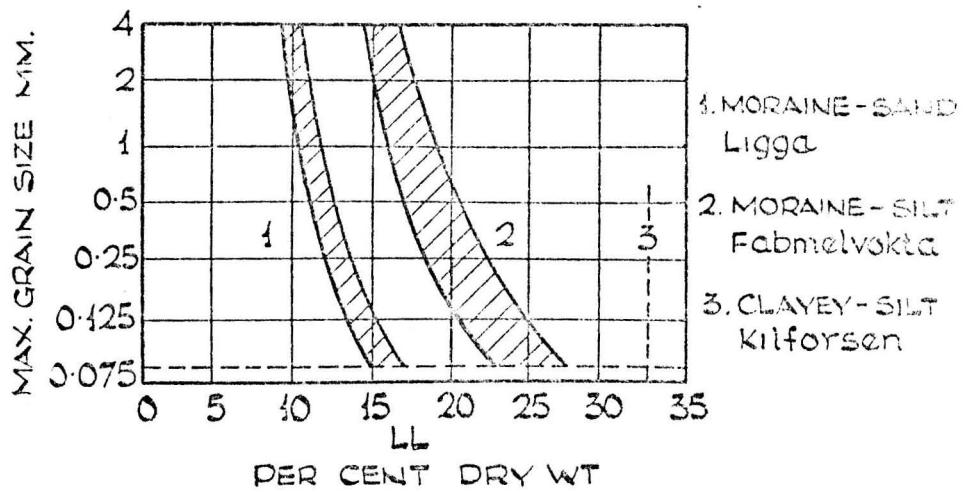
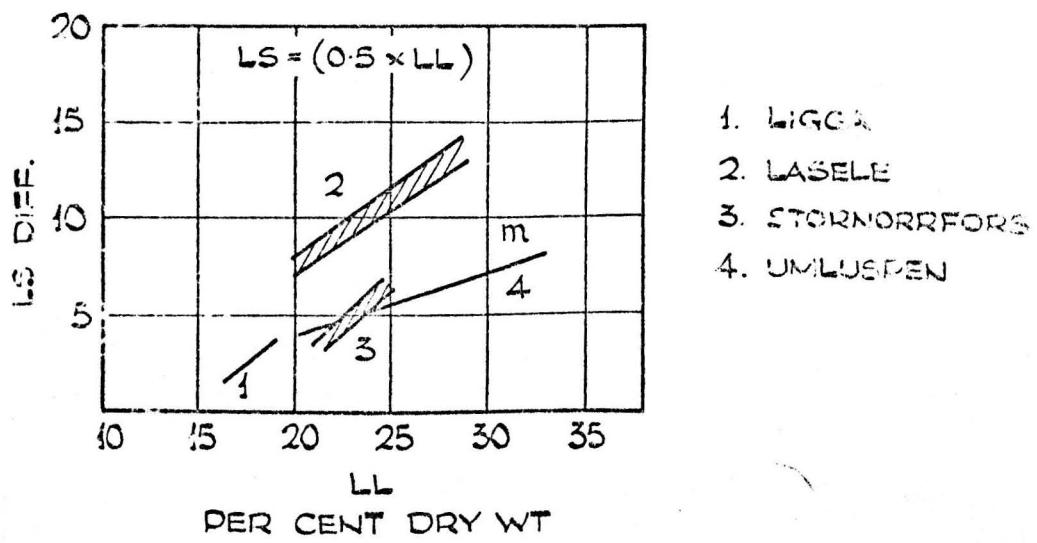


FIG. 7.1. SWEDISH CLASSIFICATION OF SOILS

FROM MORAINES. (BESKOW, 1951).



(a) RELATION BETWEEN LIQUID LIMIT  
AND MAX. GRAIN SIZE OF TYPICAL MORAINES  
AND A CLAYEY SILT  
AFTER BERNELL (1957)



(b) RELATION BETWEEN LIQUID LIMIT  
AND VALUES OF LS DIFFERENCE  
FOR MORAINES  
AFTER BERNELL (1957)

FIG. 7.2. RELATION BETWEEN LIQUID LIMIT, MAXIMUM  
GRAIN SIZE AND L.S. DIFFERENCE FOR MORAINIC SOILS.

### PARTICLE SIZE DISTRIBUTION

**DESCRIPTION OF SAMPLE :-**

DATE OF TEST :-

The graph plots Log Settling Velocity (cm/sec) on the y-axis (0 to 100) against Aperture Size (inches) on the x-axis (0.0006 to 200). Four experimental curves are shown: CORROUR FOREST SAMPLE (solid line), LAGLINGARTEN SAMPLE (dashed line), STRATHYRE SAMPLE (dash-dot line), and TALBOT'S THEORETICAL CURVE (solid line with 'n' = 0.5). The x-axis is logarithmic, with major ticks at 0.0006, 0.002, 0.006, 0.02, 0.06, 0.2, 0.6, 2.0, 6.0, 20, 60, and 200. The y-axis has major ticks at 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100.

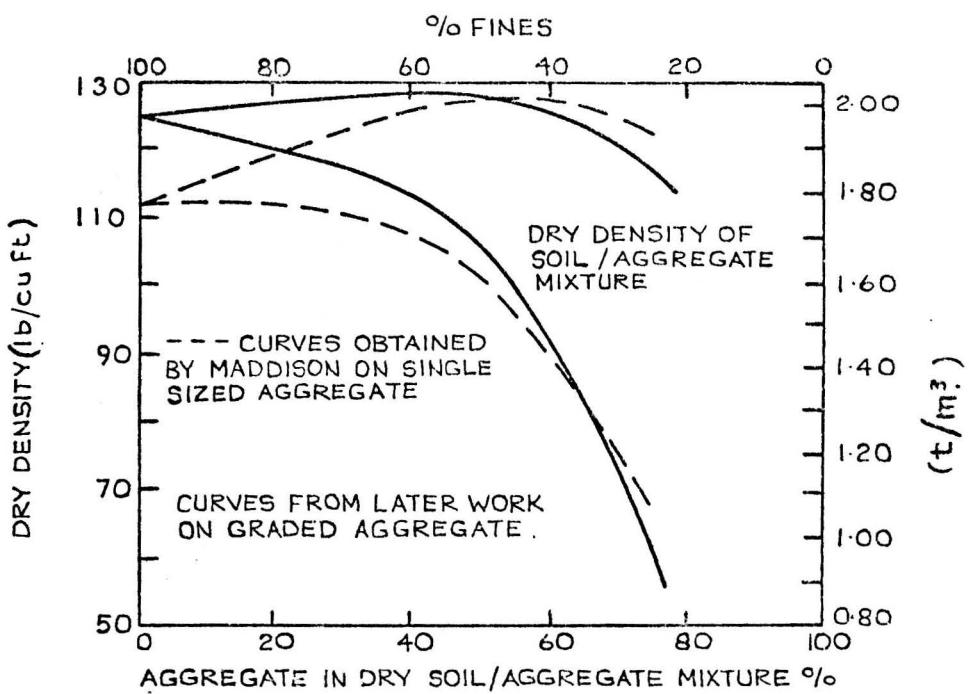


FIG. 7.4

COMPACTION OF SOIL MORTAR AT OPTIMUM MOISTURE CONTENT  
WITH DIFFERENT PERCENTAGE GRAVEL CONTENTS  
(AFTER HIGHWAY RESEARCH BOARD 1962)

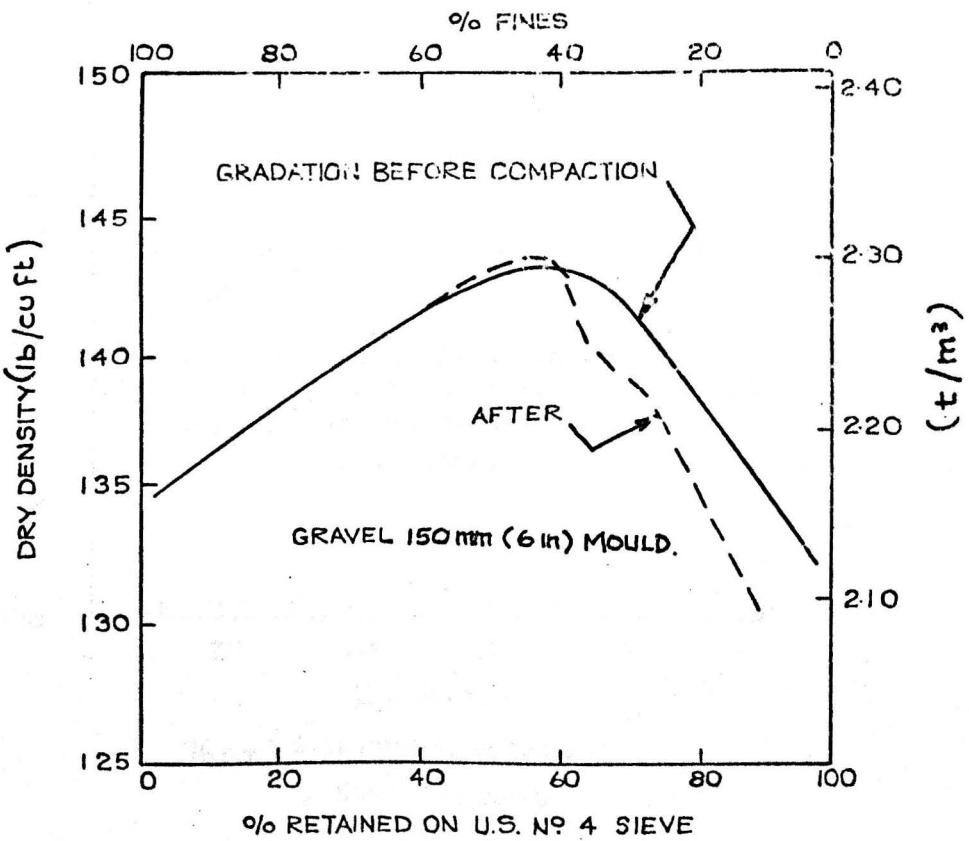
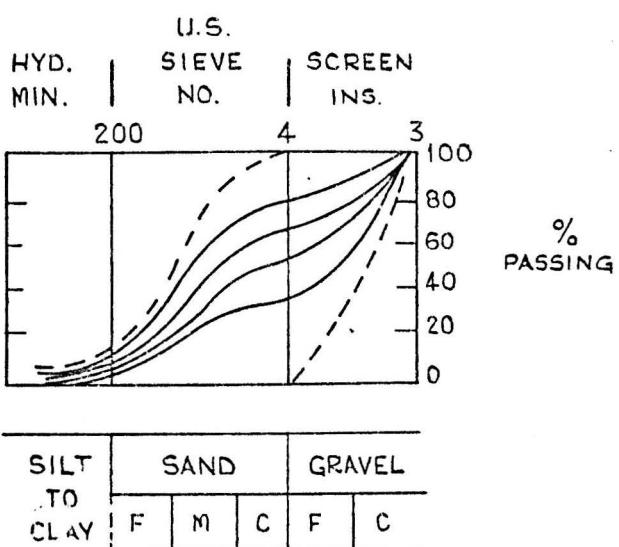


FIG. 7.5

DRY DENSITY-GRAVEL CONTENT RELATIONSHIP  
(AFTER MAINFORT AND LAWTON 1952)



GRADATIONS USED IN INVESTIGATION OF  
COMPACTION CHARACTERISTICS OF  
GRAVELLY SANDS.

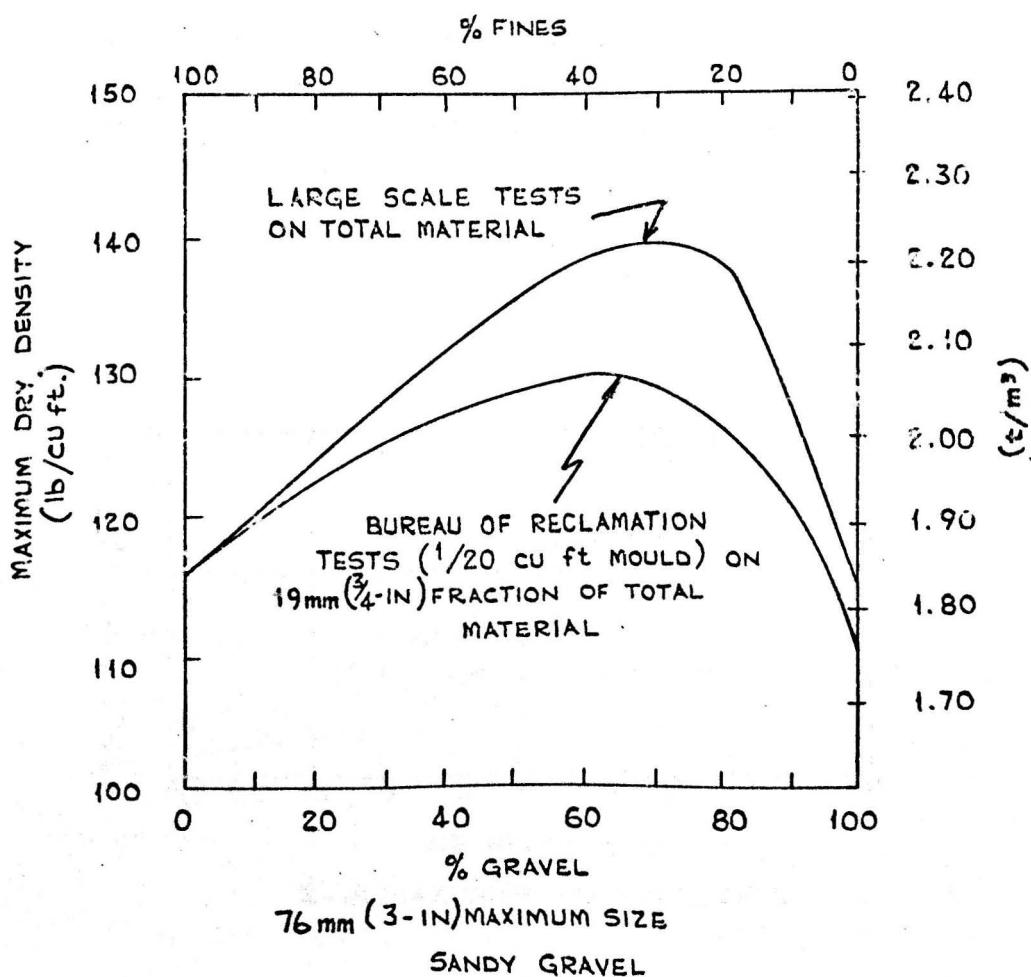


FIG. 7.6 RELATIONSHIP BETWEEN MAXIMUM DRY DENSITY AND GRAVEL CONTENT. (AFTER HOLTZ & LOWITZ, 1957)

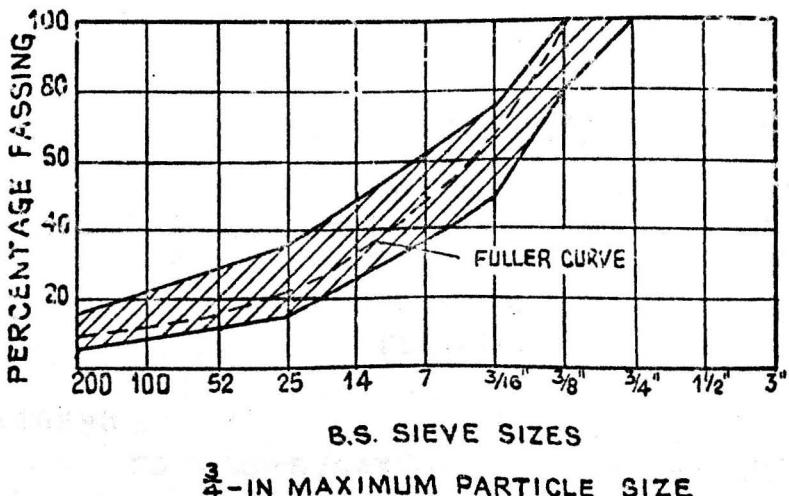
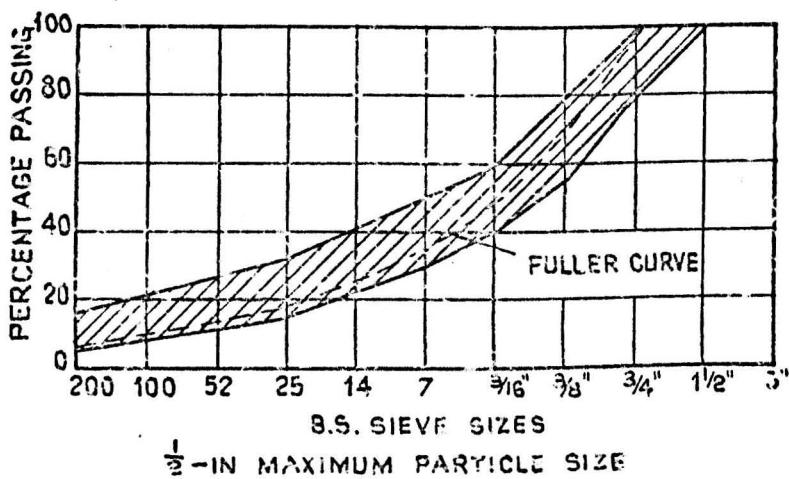
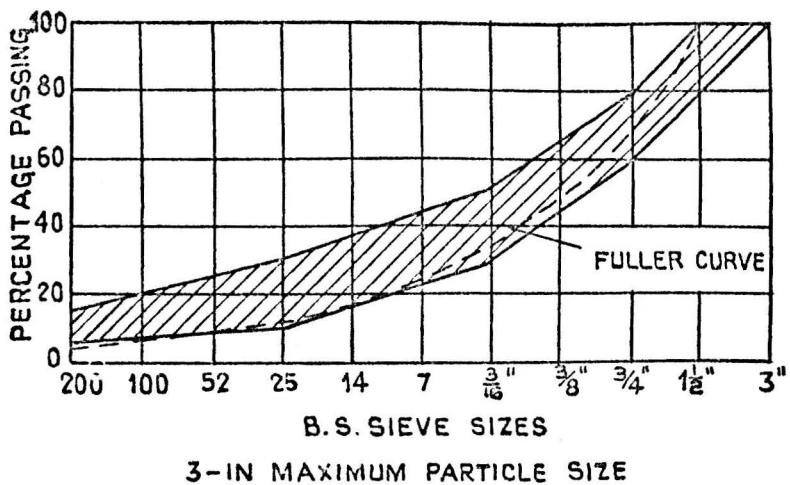
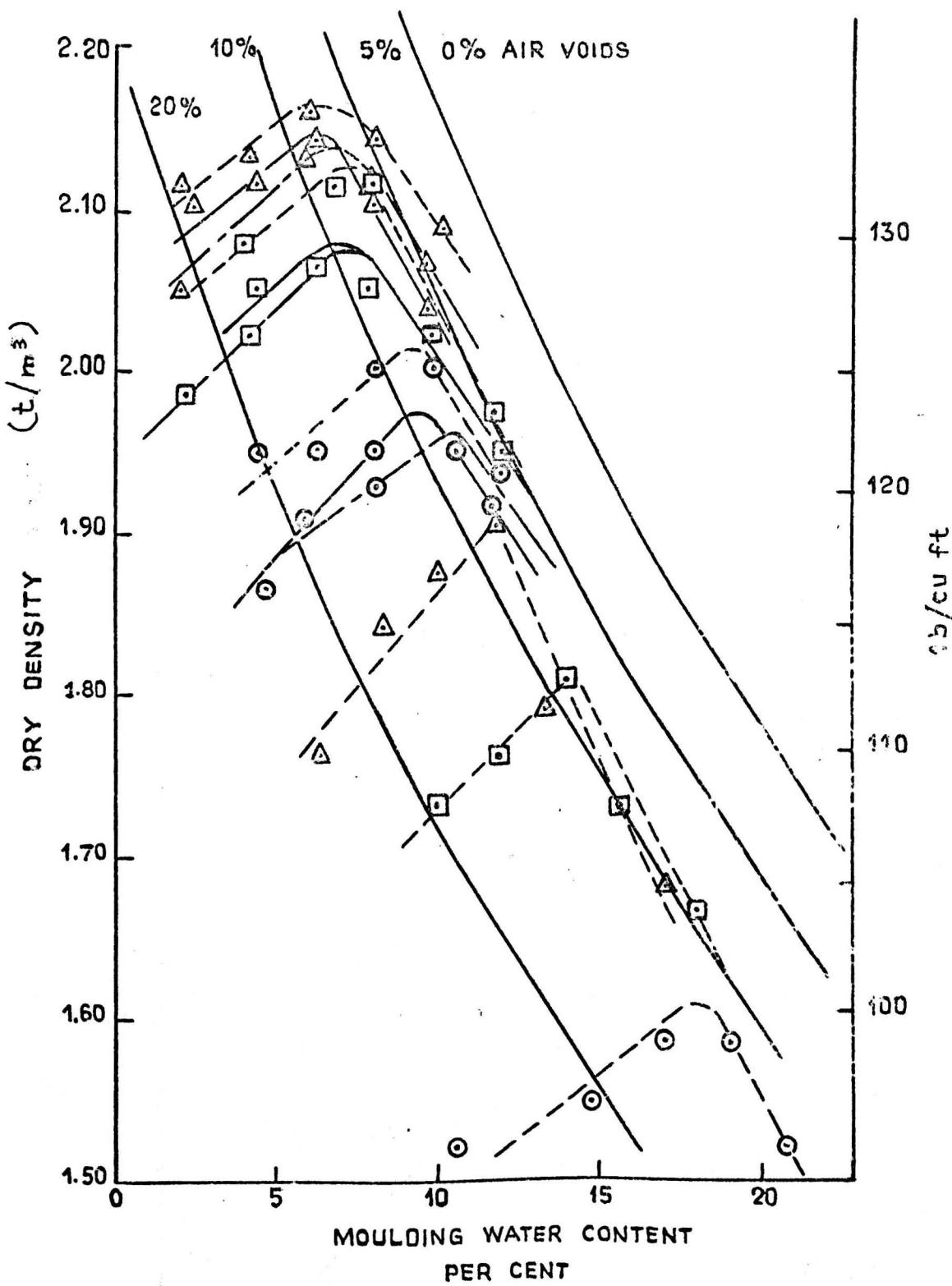


FIG. 7.7

SUGGESTED PARTICLE SIZE LIMITS  
FOR BASE MATERIALS

**EXTRACTED FROM "SOIL MECHANICS  
FOR ROAD ENGINEERS" H.M.S.O.**

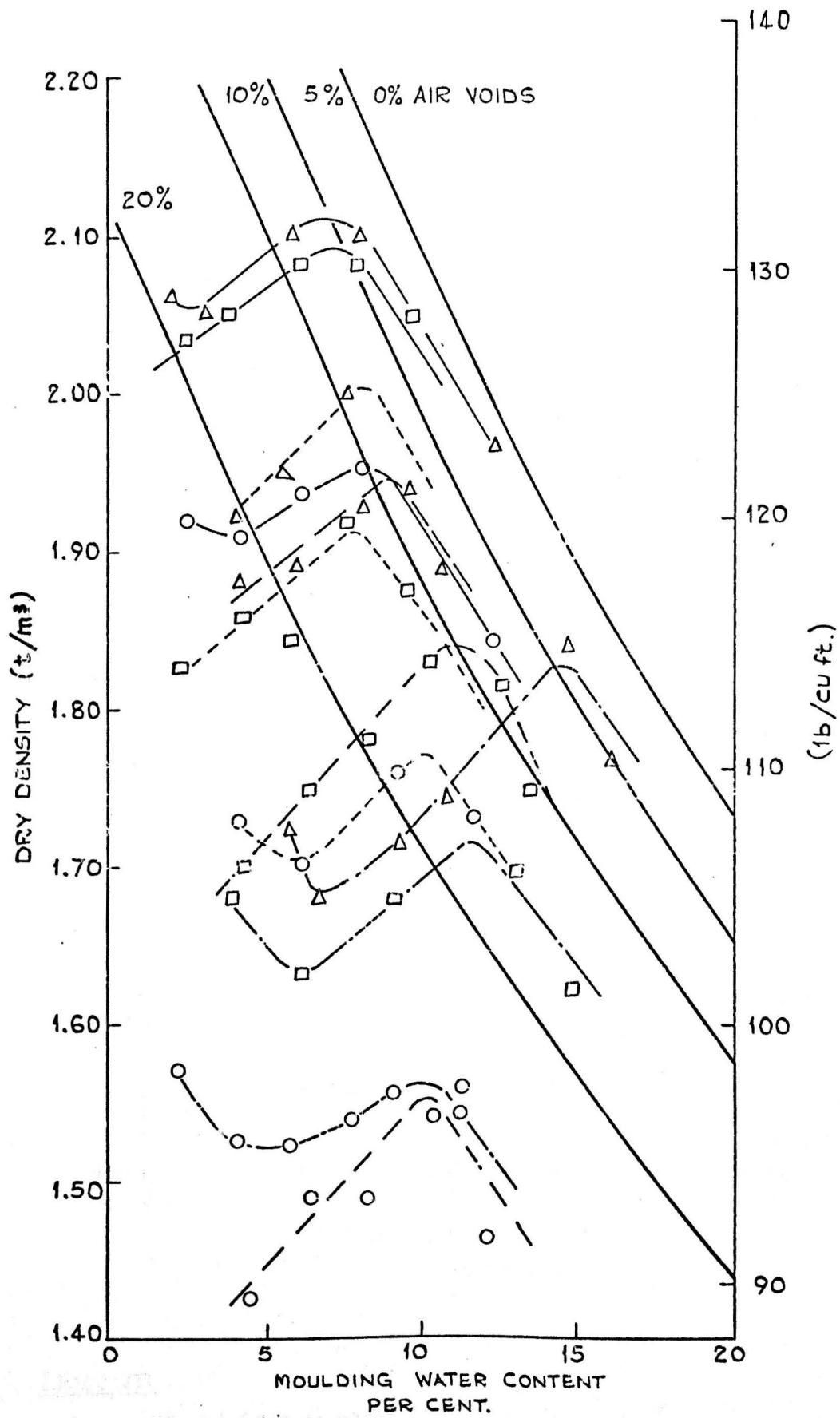


#### LEGEND

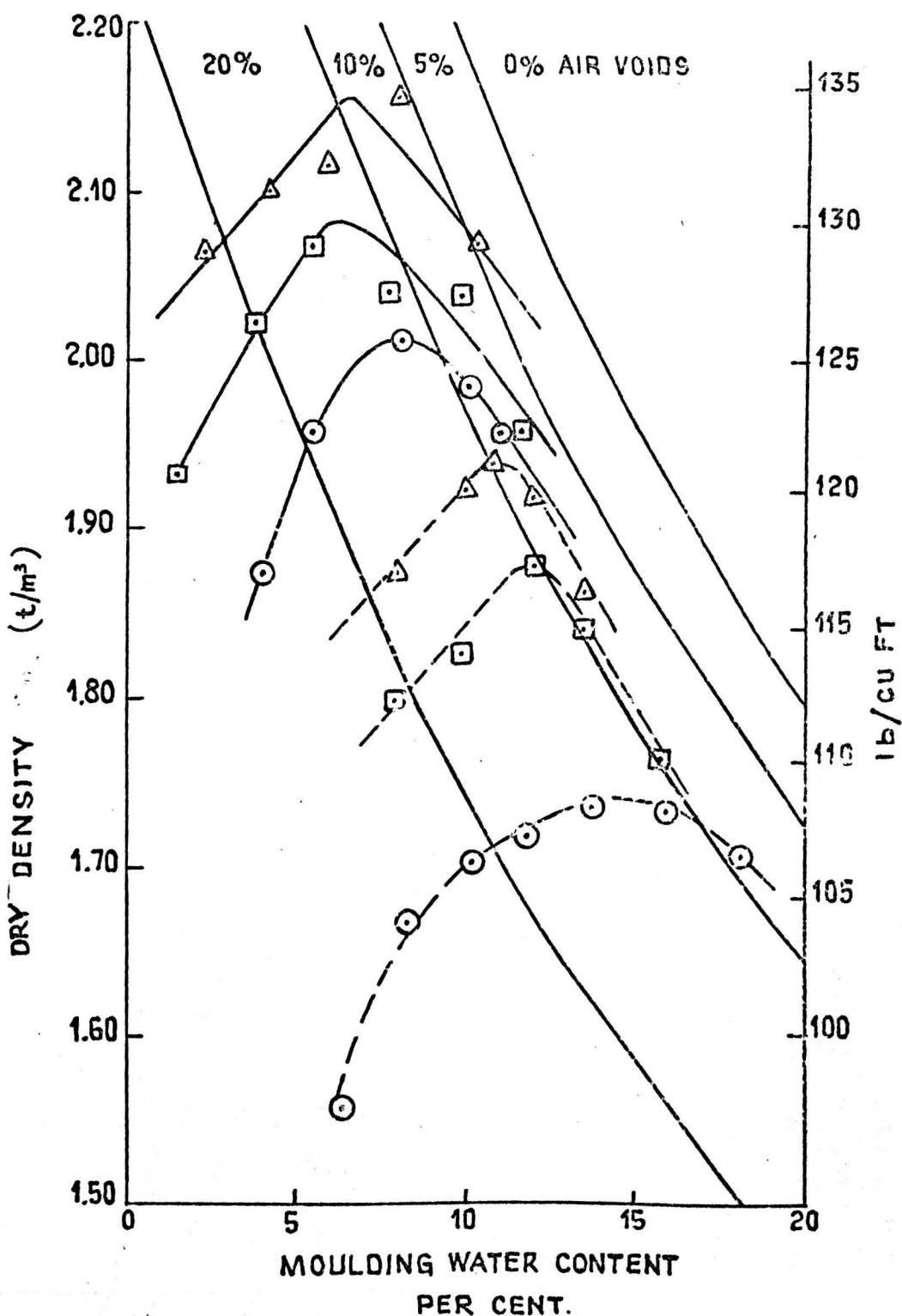
- 55 BLOWS/LAYER
- 25 BLOWS/LAYER
- 10 BLOWS/LAYER
- — — 0% FINES
- - - - - 30% "
- — — 40% "
- — — 100% "

TYPICAL RELATIONSHIPS BETWEEN MOULDING CONTENT AND DRY DENSITY FOR VARYING COMPACTIVE EFFORT FOR LAGLINGARTEN TILL.

FIG. 7.8



**FIG. 7.9. TYPICAL RELATIONSHIPS BETWEEN MOULDING WATER CONTENT AND DRY DENSITY FOR VARYING COMPACTIVE EFFORT AND PERCENTAGE FINES FOR CORROUR TILL.**



#### LEGEND

- ▲ 55 BLOWS / LAYER
- 25 BLOWS / LAYER
- 10 BLOWS / LAYER
- 50 % FINES
- - - 100 % FINES

FIG. 7.10 TYPICAL RELATIONSHIPS BETWEEN MOULDING WATER CONTENT AND DRY DENSITY FOR VARYING COMPACTIVE EFFORT FOR STRATHYRE TILL.

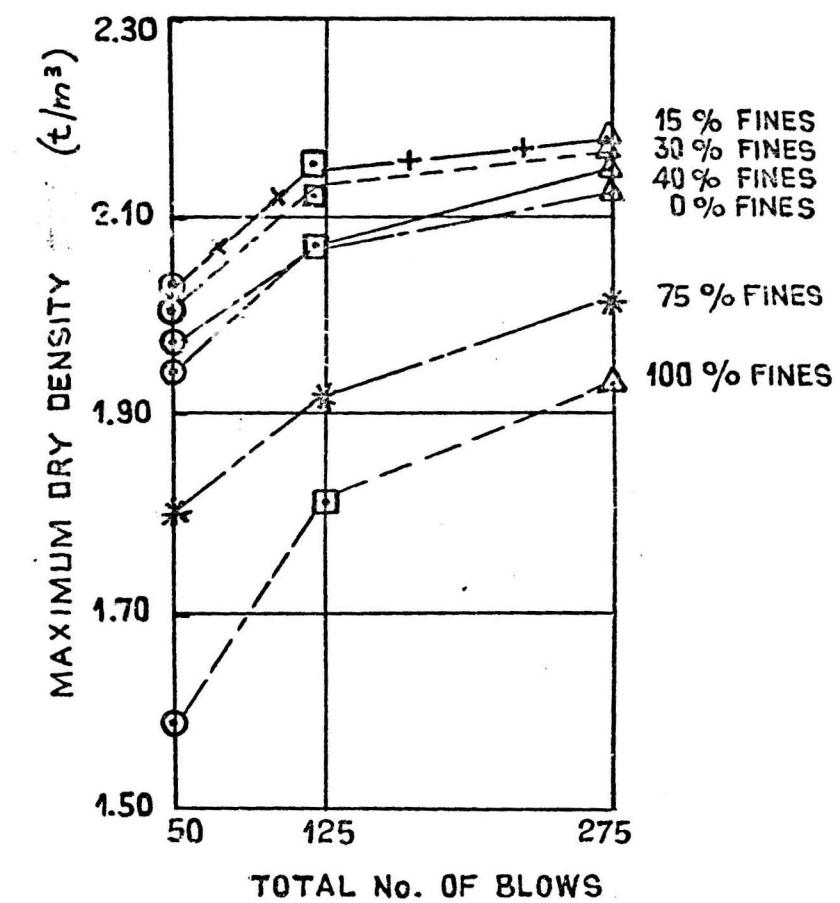
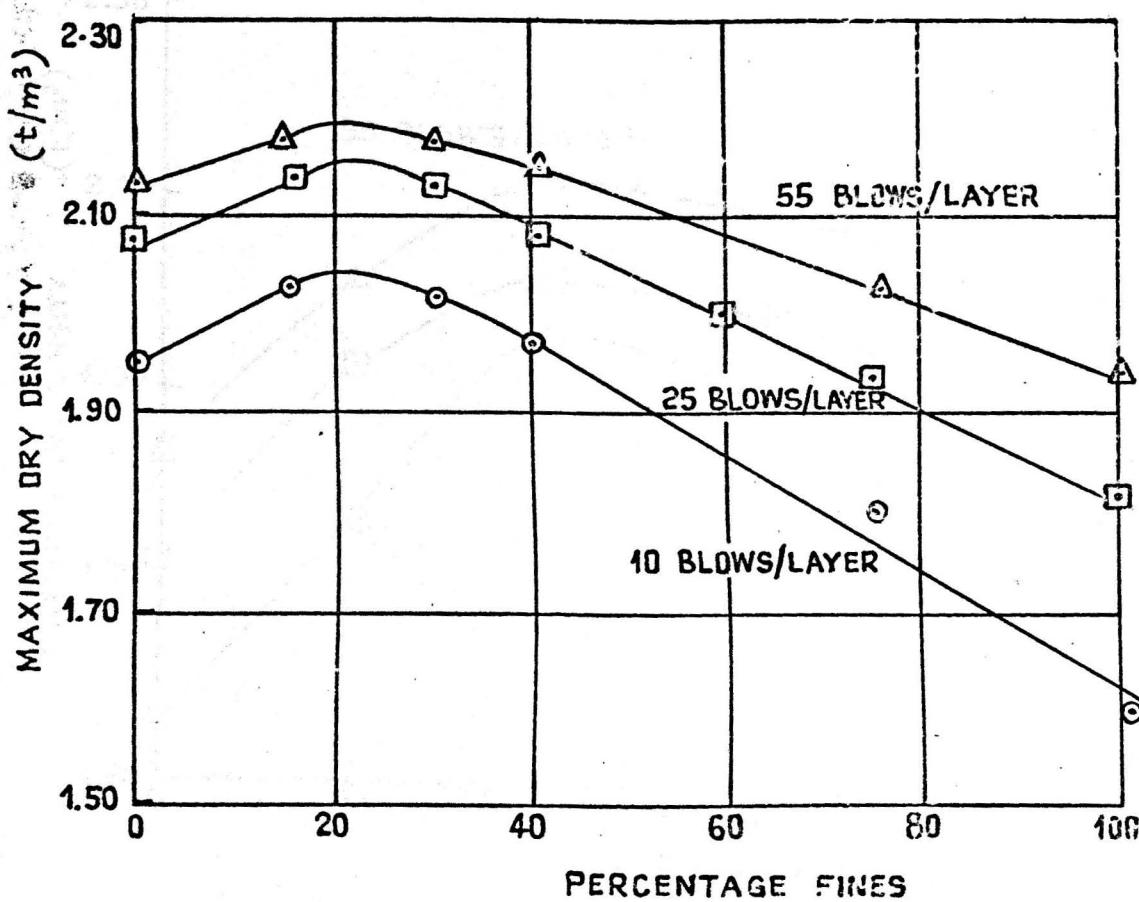


FIG. 7.11 RELATIONSHIP BETWEEN PERCENTAGE FINE CONTENT AND  
MAXIMUM DRY DENSITY FOR VARYING COMPACTIVE EFFORT FOR  
LAGLINGARTEN TILLS

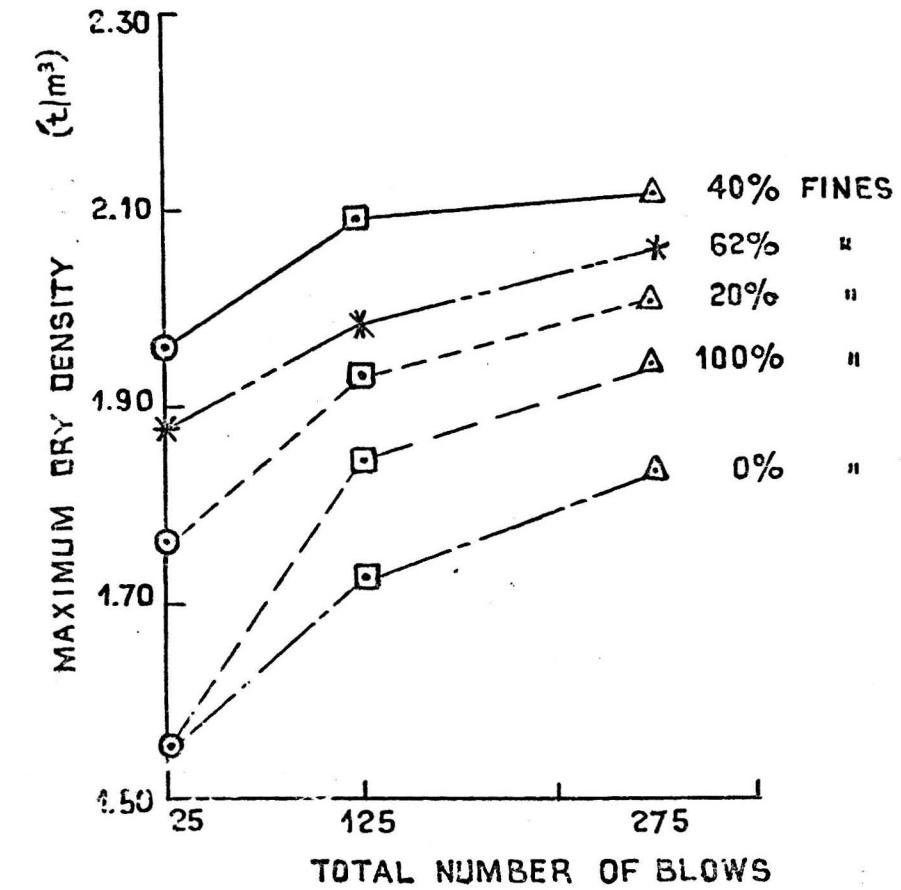
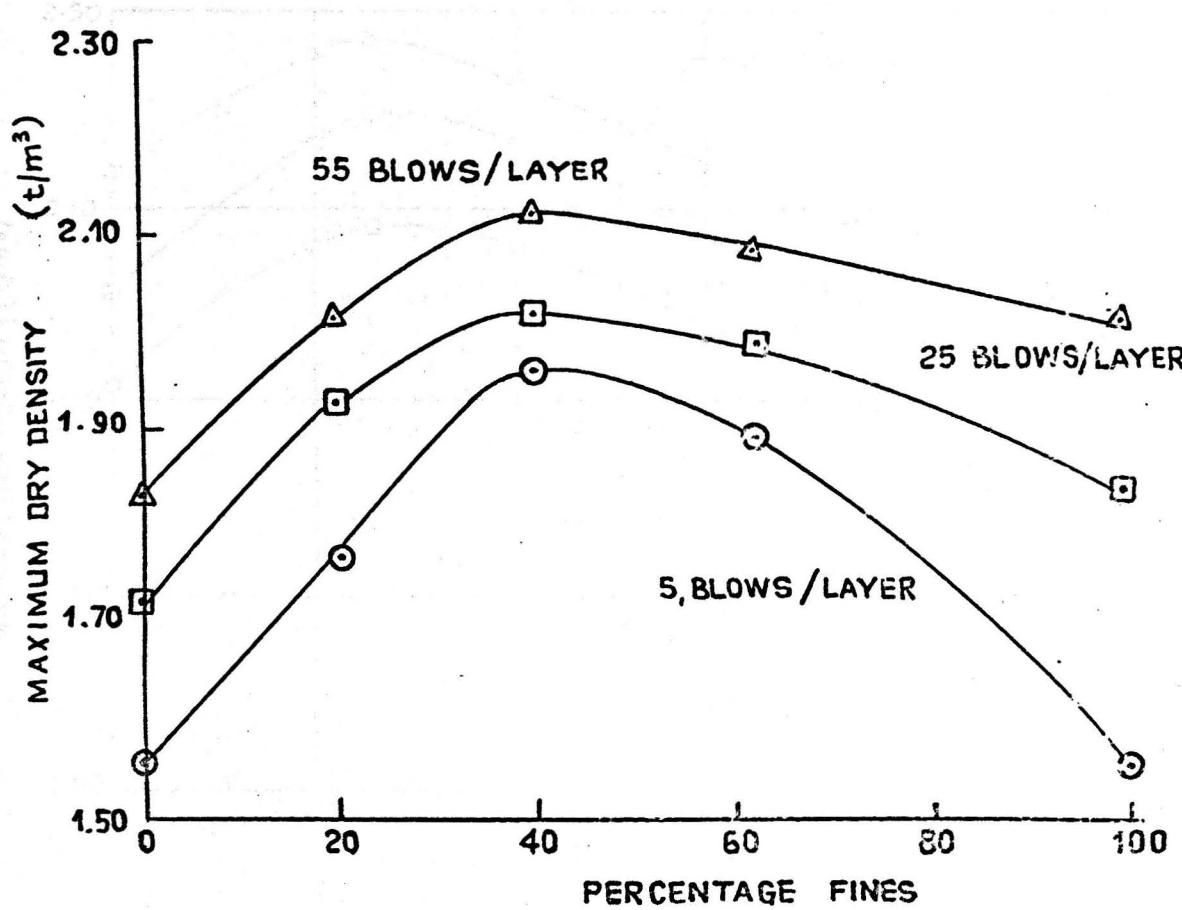
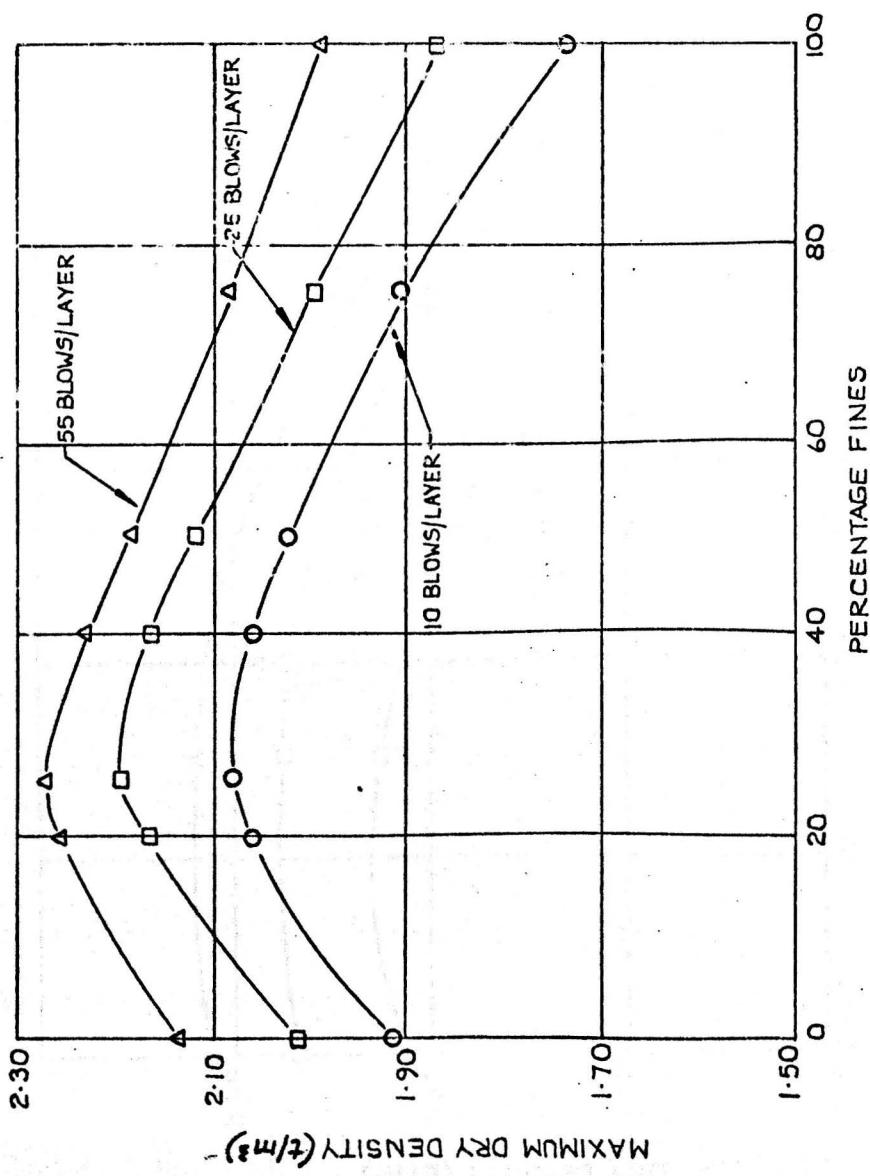
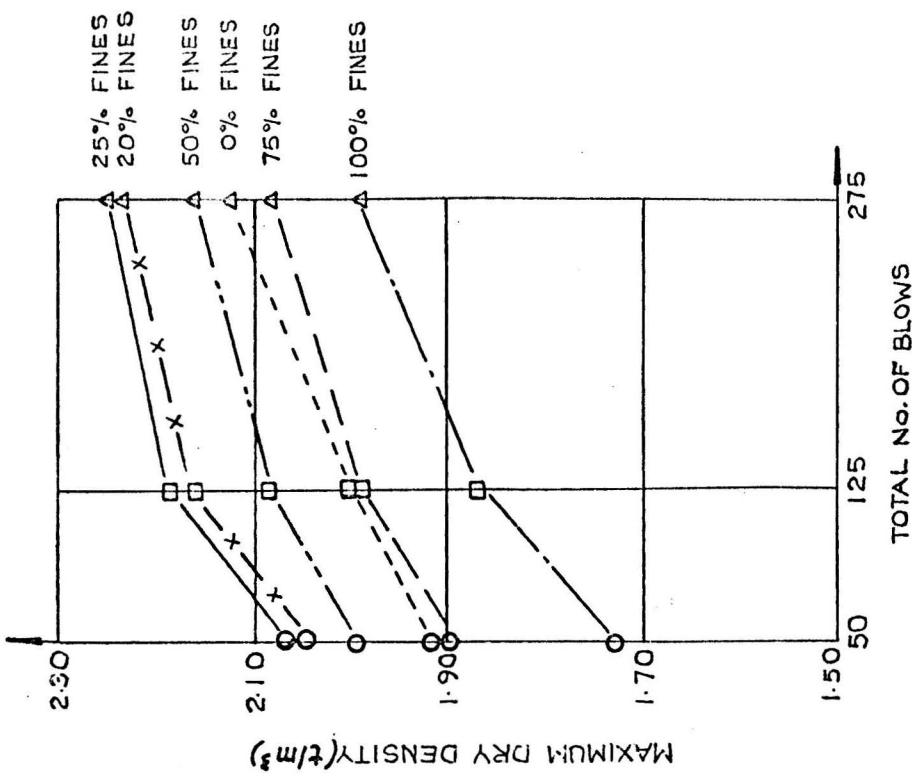


FIG. 7-12 RELATIONSHIP BETWEEN PERCENTAGE FINE CONTENT AND  
MAXIMUM DRY DENSITY FOR VARYING COMPACTIVE EFFORT FOR  
CORROUR TILLS.



**FIG 7.13** RELATIONSHIP BETWEEN PERCENTAGE FINES CONTENT AND MAXIMUM DRY DENSITY FOR VARYING COMPACTIVE EFFORT IN STRATHYRE TILLS.

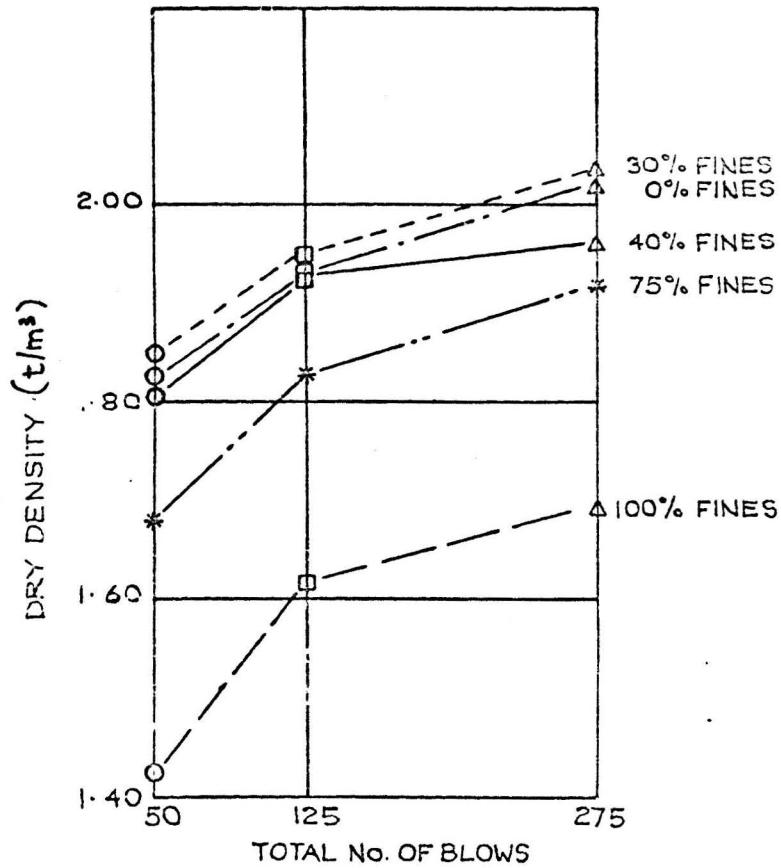
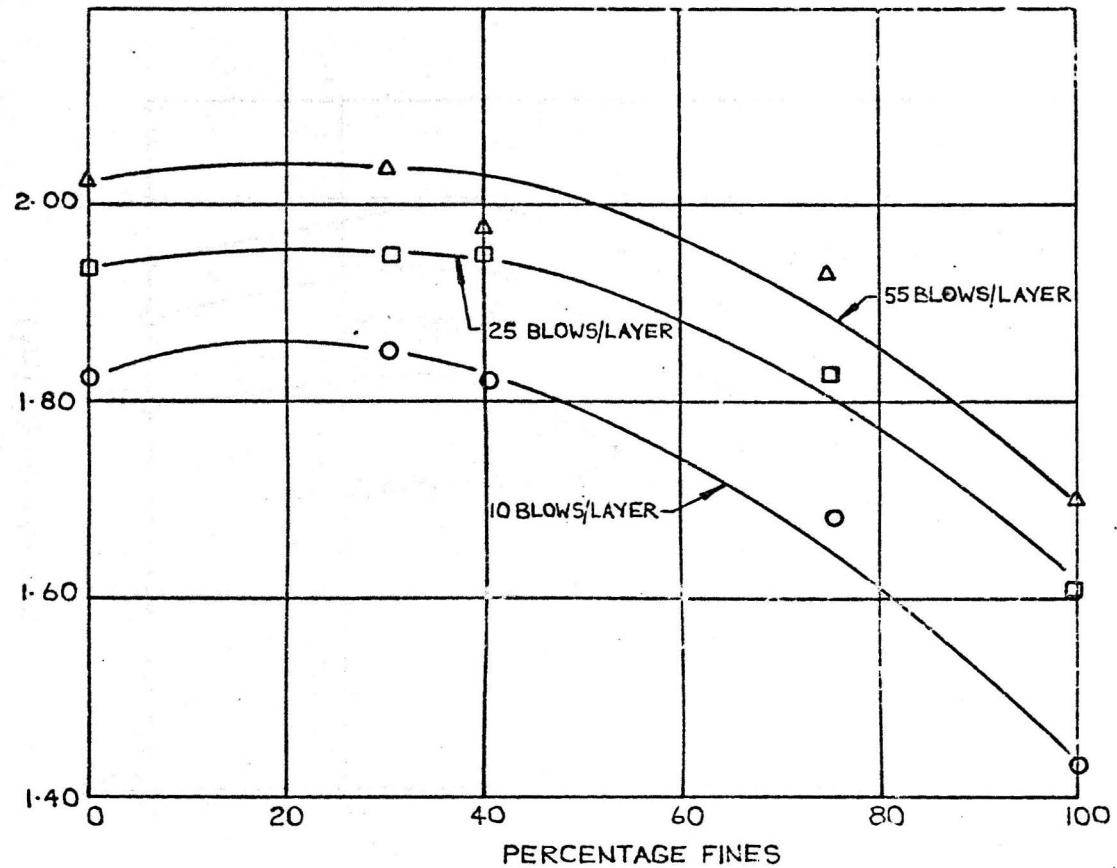
DRY DENSITY ( $t/m^3$ )

FIG. 7.14 RELATIONSHIP BETWEEN PERCENTAGE FINE CONTENT AND DRY DENSITY AT OPTIMUM WATER CONTENT PLUS 5 % FOR VARYING COMPACTIVE EFFORT FOR LAGLINGARTEN TILL.

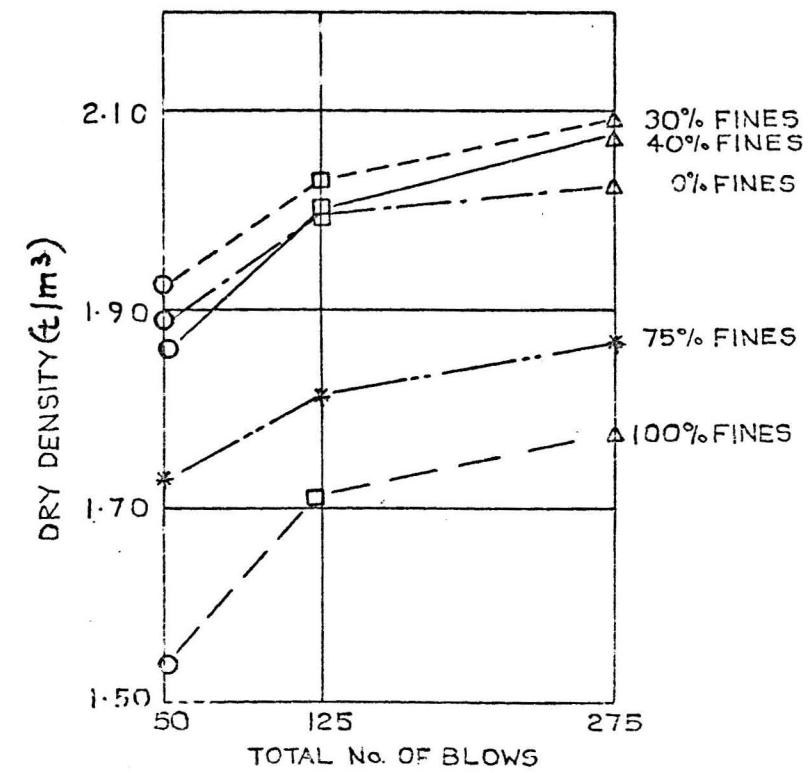
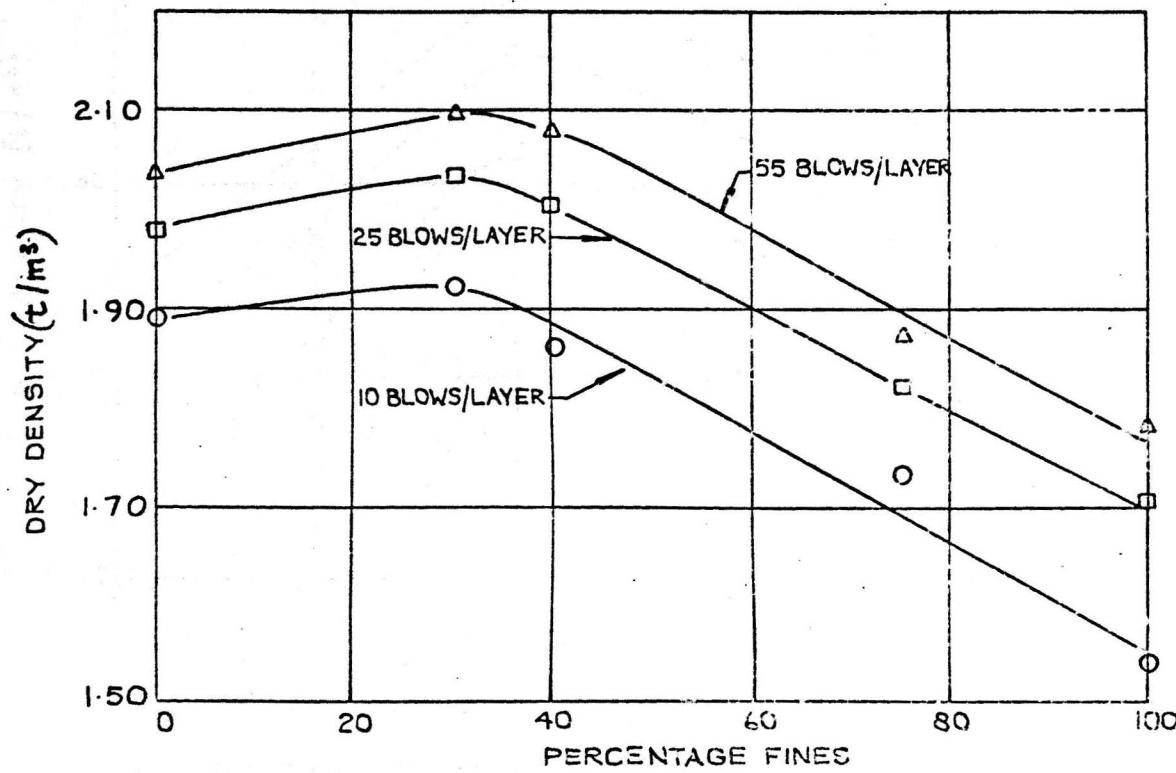


FIG. 7.15 RELATIONSHIP BETWEEN PERCENTAGE FINE CONTENT AND DRY DENSITY AT OPTIMUM WATER CONTENT MINUS 5% FOR VARYING COMPACTIVE EFFCRT FOR LAGLINGARTEN TILL.

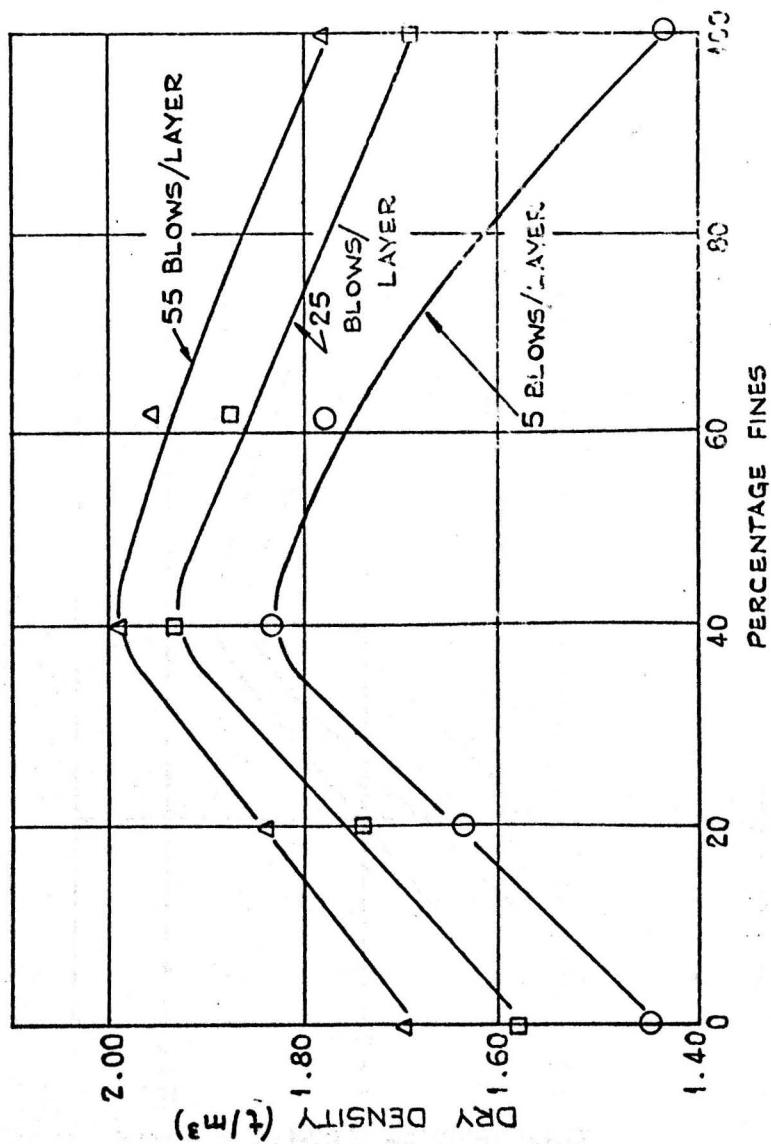
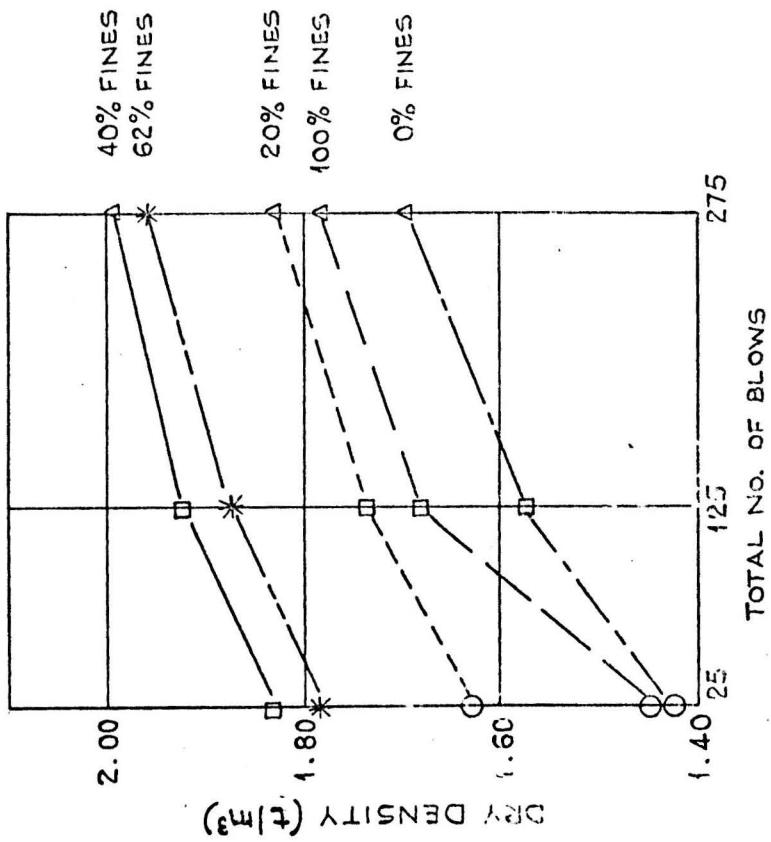


FIG. 7.16. RELATIONSHIP BETWEEN PERCENTAGE FINE CONTENT AND DRY DENSITY AT OPTIMUM WATER CONTENT PLUS 5 PER CENT FOR VARYING COMPACTIVE EFFORT FOR CORROUR TILL

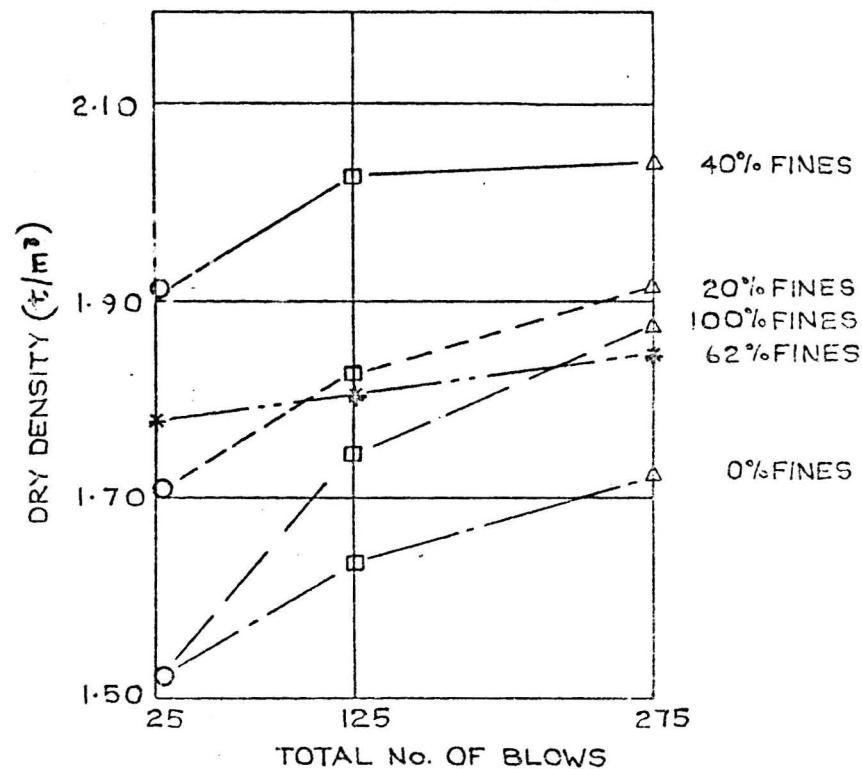
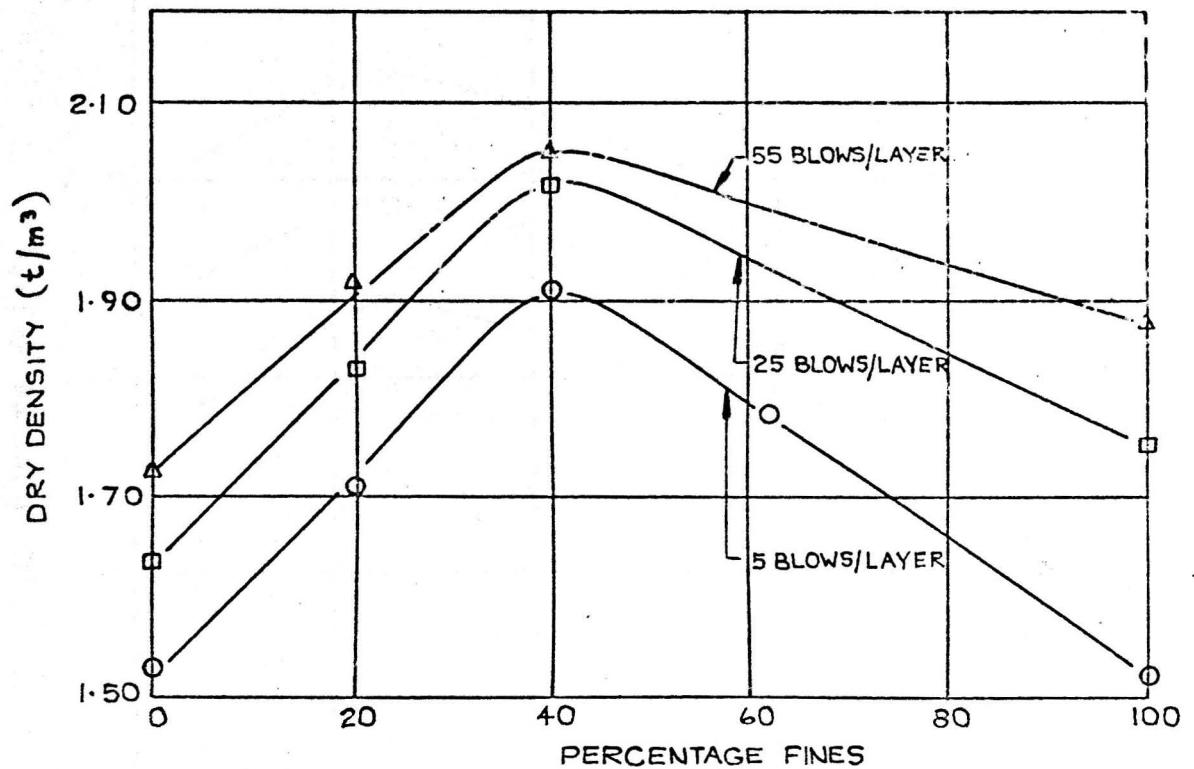


FIG. 7.17 RELATIONSHIP BETWEEN PERCENTAGE FINE CONTENT AND DRY DENSITY AT OPTIMUM WATER CONTENT MINUS 5% FOR VARYING COMPACTIVE EFFORT FOR CORROUR TILL

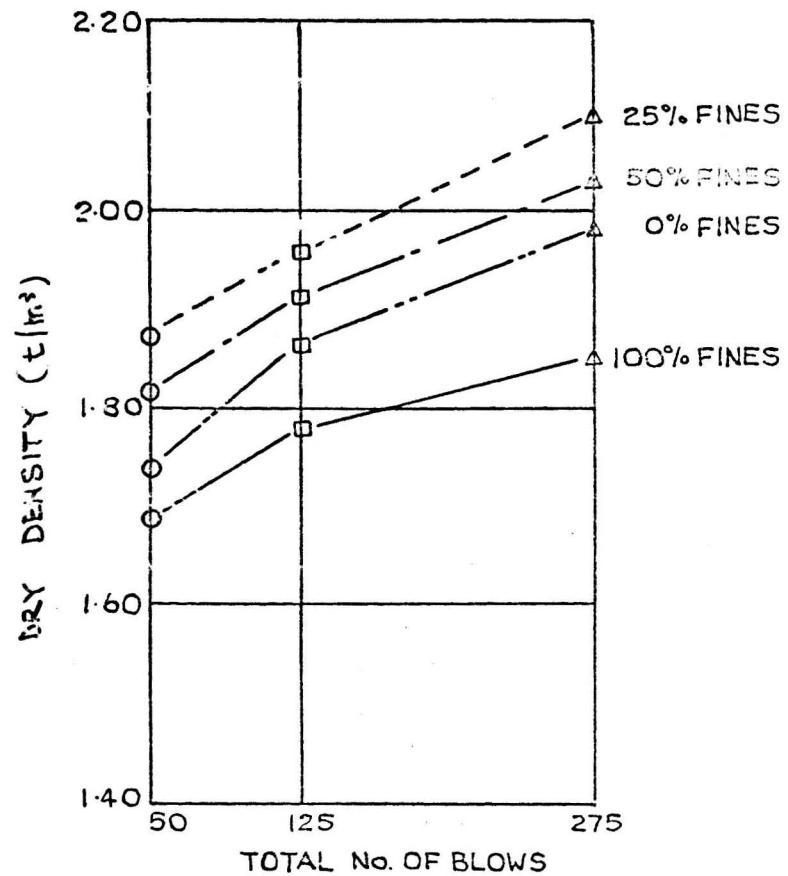
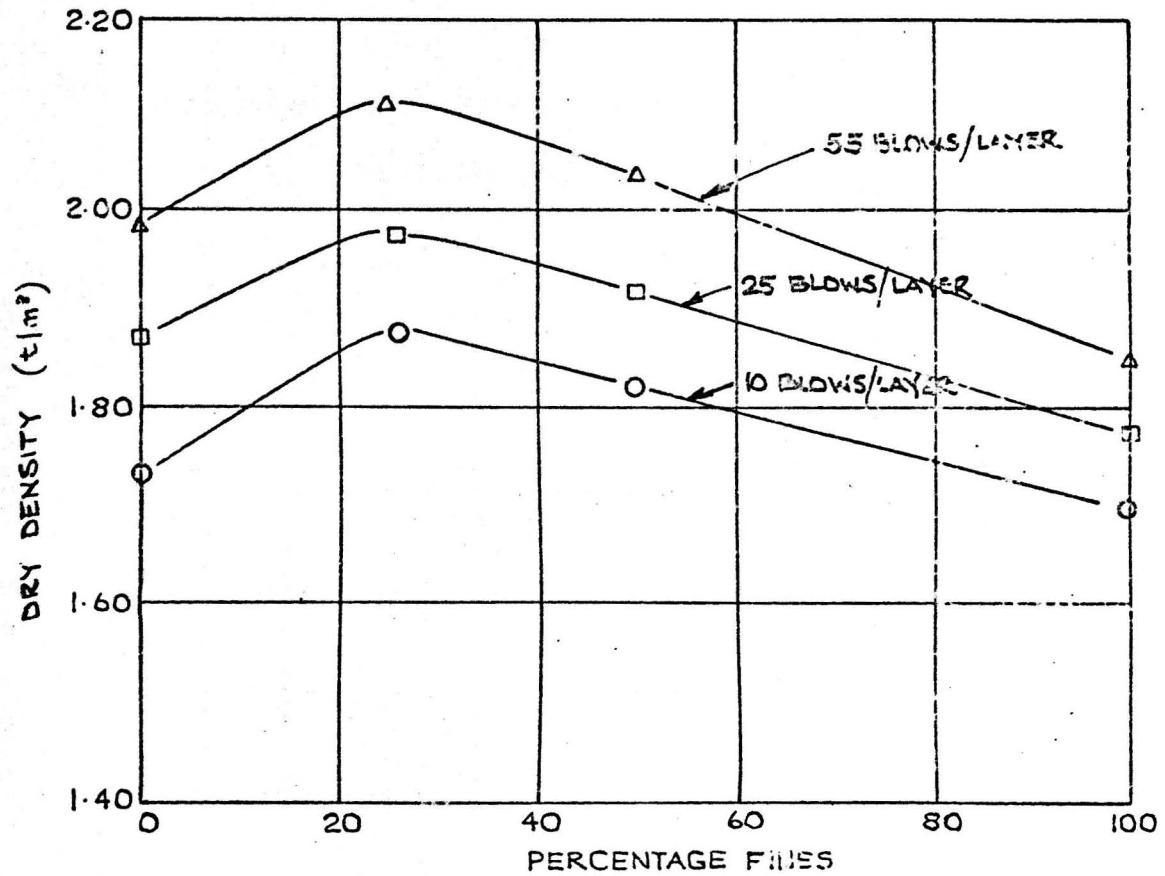
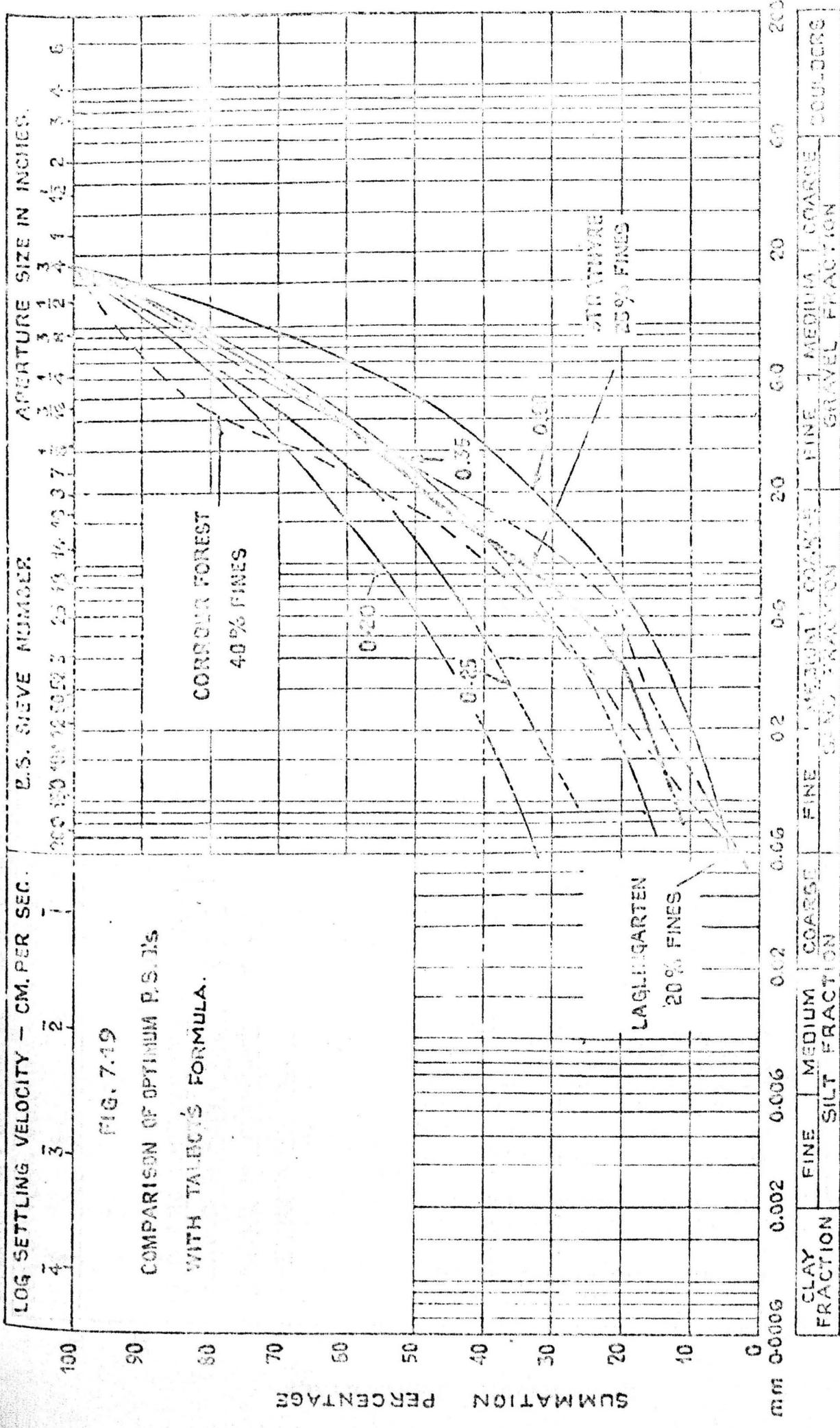


FIG. 7.18 RELATIONSHIP BETWEEN PERCENTAGE FINES CONTENT AND DRY DENSITY OF OPTIMUM WATER CONTENT MINUS 5% FOR VARYING COMPACTIVE EFFORT FOR STRATHYRE TILL

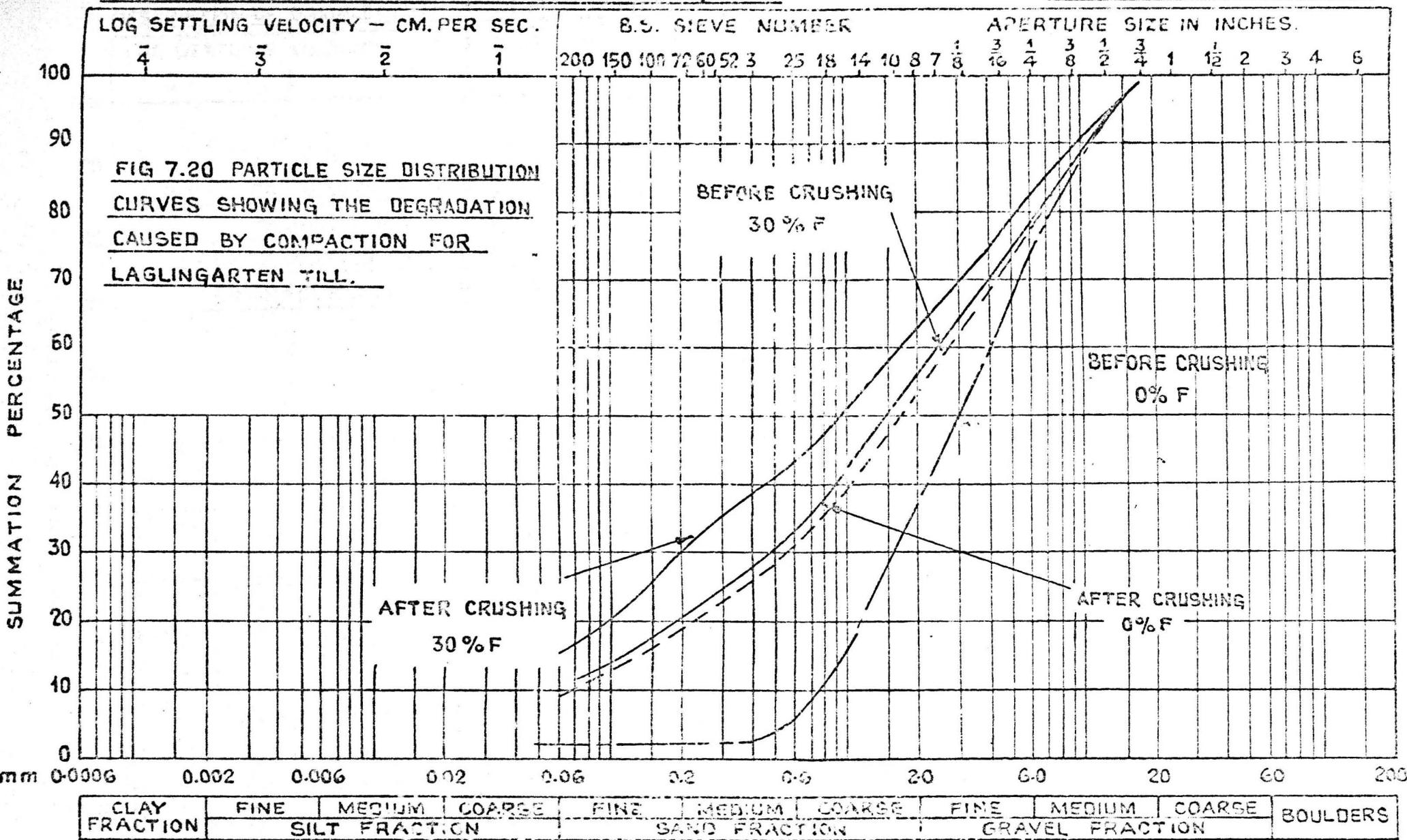
NOTE: DATA FOR OPTIMUM MOISTURE CONTENT PLUS 5 PER CENT WAS NOT OBTAINED



PARTICLE SIZE DISTRIBUTION

DESCRIPTION OF SAMPLE:- COMPACTED AT 55 BLOWS/LAYER

DATE OF TEST:-



## PARTICLE SIZE DISTRIBUTION

DESCRIPTION OF SAMPLE:- COMPACTED AT 55 BLOWS/LAYER

DATE OF TEST:-

**FIG 7.21 PARTICLE SIZE DISTRIBUTION**

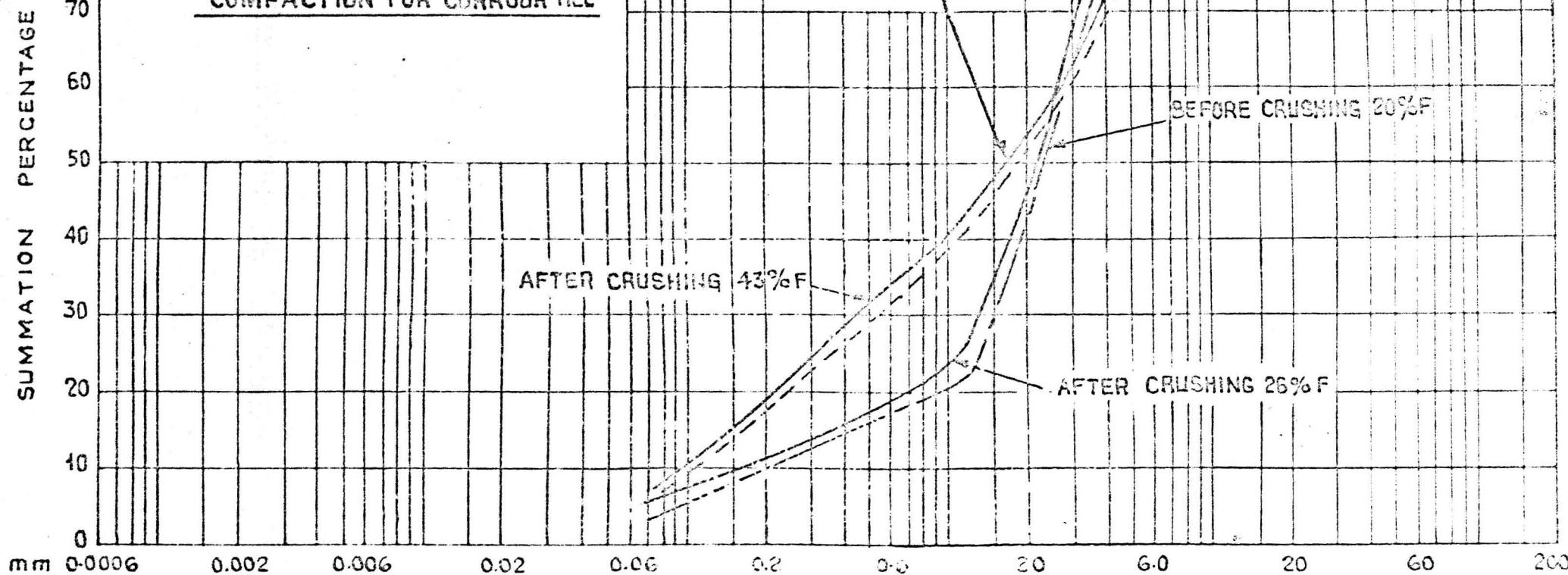
**CURVES SHOWING THE DEGRADATION CAUSED BY COMPACTION FOR CORROUR TILL**

The graph plots Log Settling Velocity (cm/sec) on the y-axis (0 to 100) against Aperture Size (inches) on the x-axis (0.0006 to 20). The top header provides conversion factors: LOG SETTLING VELOCITY - CM. PER SEC. (4, 3, 2, 1), R.S. SIEVE NUMBER (200, 150, 100, 72, 60, 52, 3, 25, 18, 14, 10, 8, 7, 1/8), and APERTURE SIZE IN INCHES (3/16, 1/4, 3/8, 1/2, 3/4, 1, 1/2, 2, 3, 4, 6).

The graph displays four sets of curves representing different fines fractions (F):

- BEFORE CRUSHING 40% F:** Shows the most degraded curve, shifted furthest to the right.
- BEFORE CRUSHING 20% F:** Shows a moderately degraded curve.
- AFTER CRUSHING 43% F:** Shows a curve shifted to the right.
- AFTER CRUSHING 26% F:** Shows the least degraded curve, closest to the original state.

Dashed lines connect corresponding curves for each fines fraction, illustrating the relationship between the original state and the crushed states.



CLAY FRACTION	FINE			COARSE	FINE			COARSE	FINE			COARSE	GOULDERS
	SILT FRACTION				SAND FRACTION				GRAVEL FRACTION				

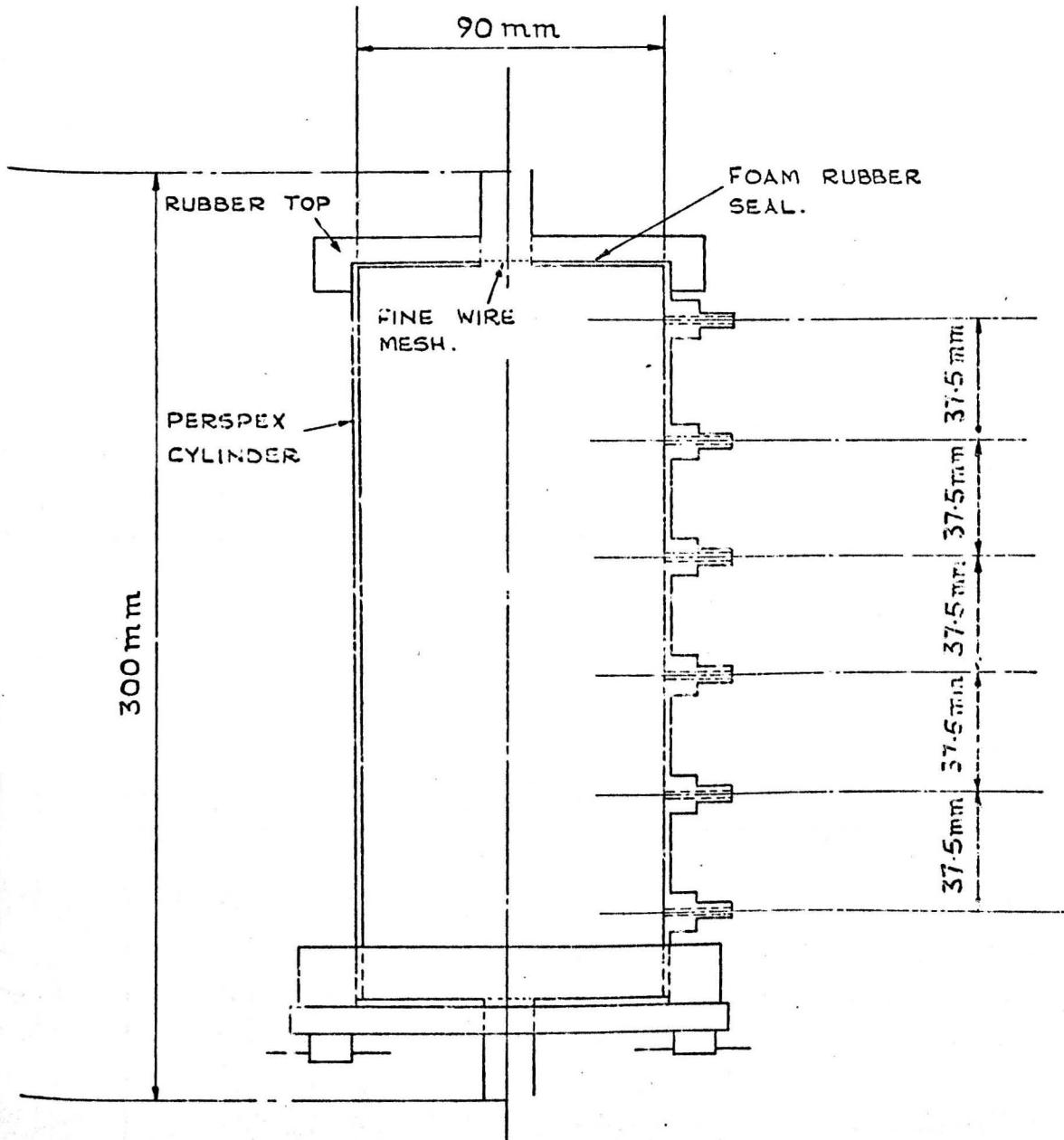


FIG. 7.22. DIMENSIONS OF PERMEABILITY CYLINDER.



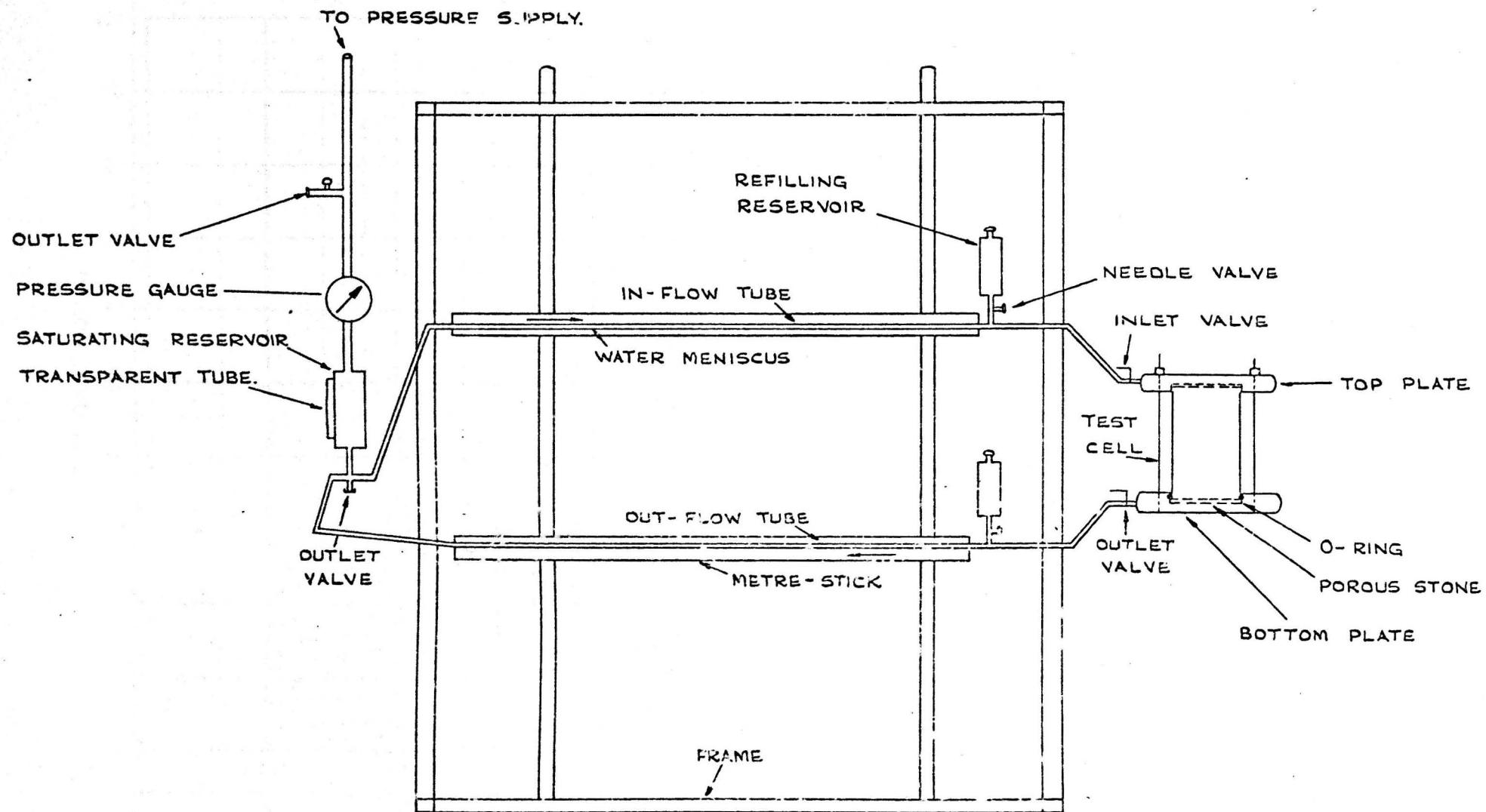


FIG. 7.24 CONSTANT HEAD PERMEABILITY APPARATUS (AFTER YOUNGER & LIM, 1969)

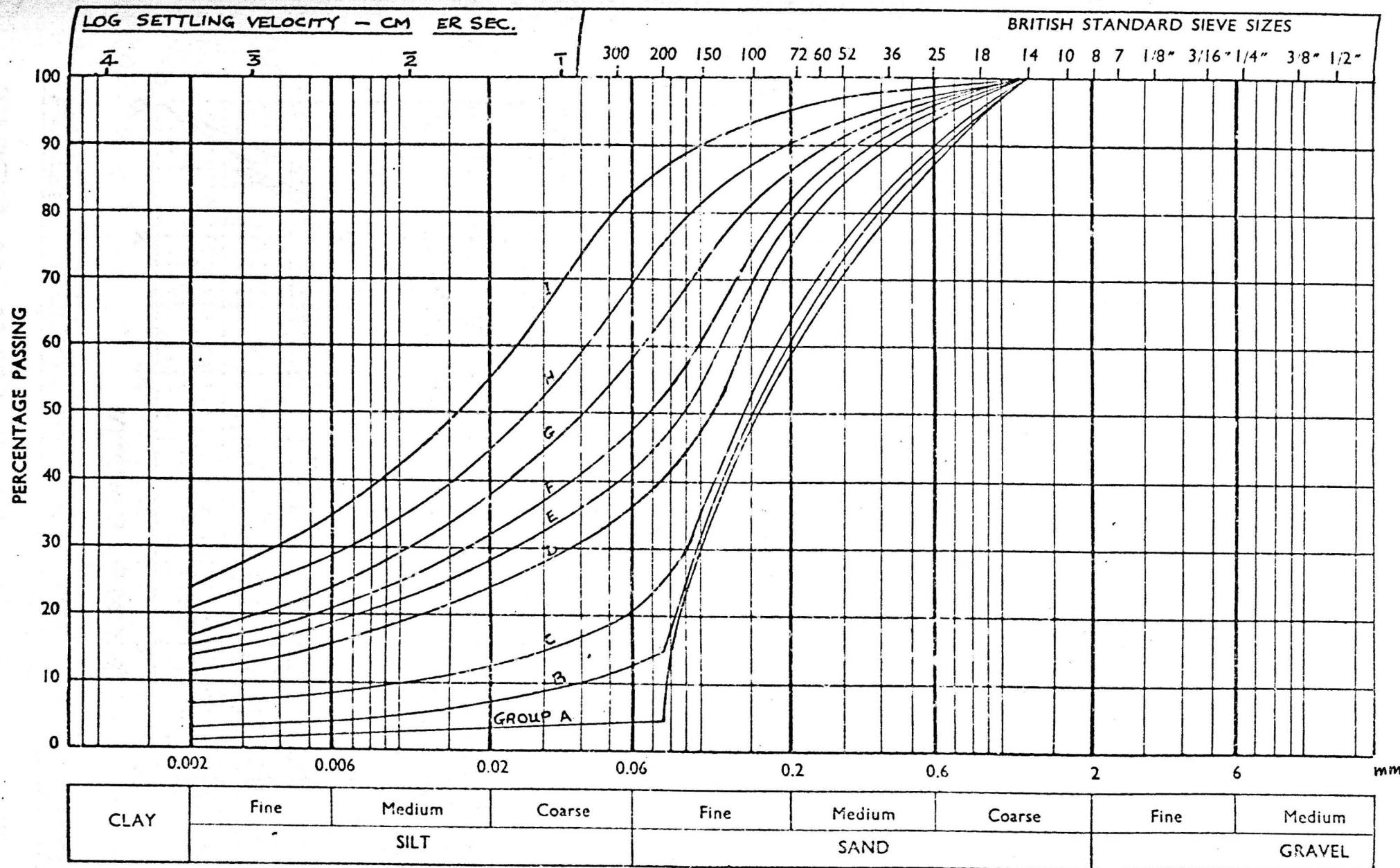


FIG. 7.25. PARTICLE SIZE DISTRIBUTIONS OF ARTIFICIALLY GRADED BACKWATER TILL.

(YOUNGER AND LIM 1969)

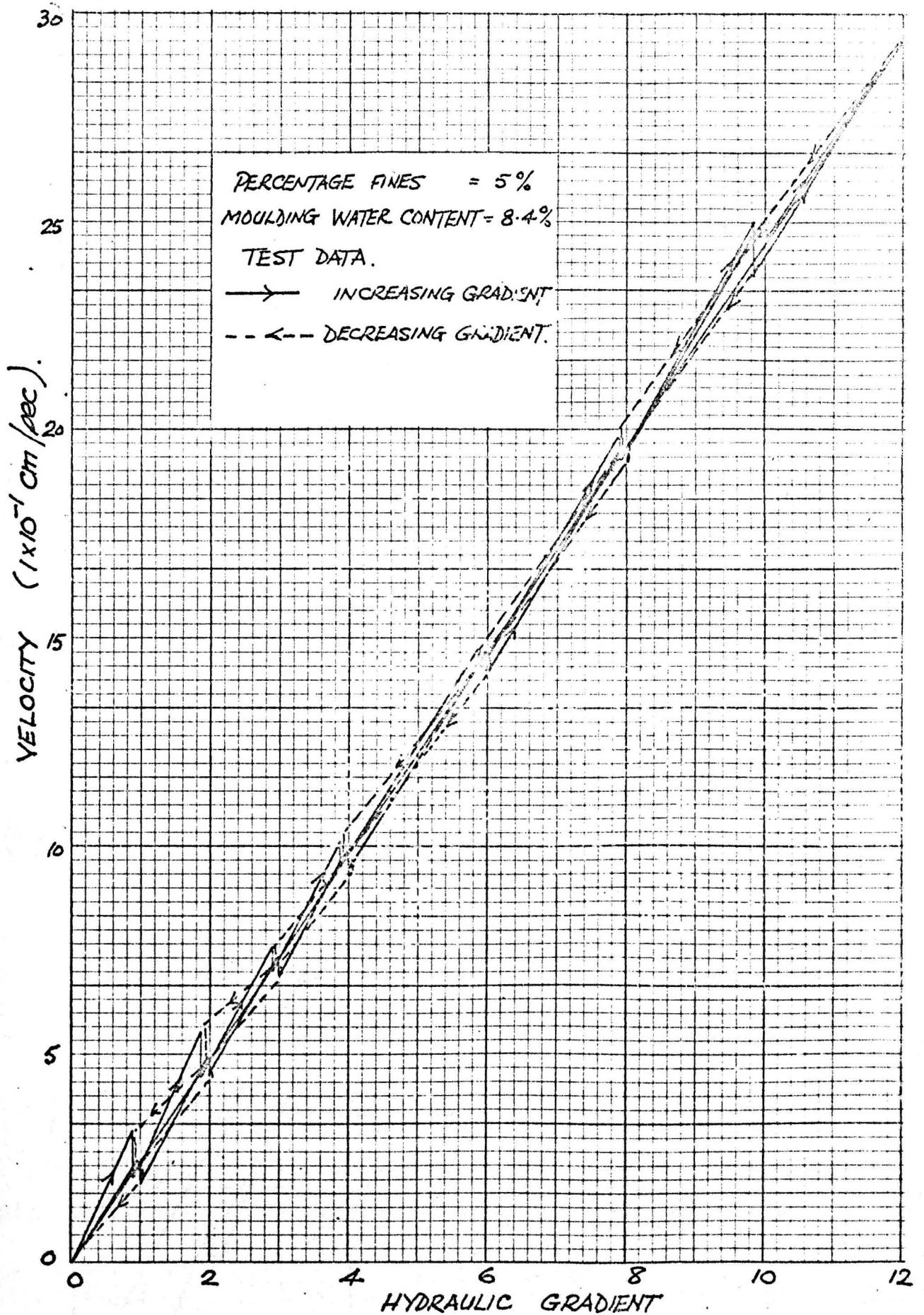


FIG 7.26. VELOCITY- GRADIENT PLOT FOR 5 PER CENT FINES

COMPACTED DRY OF OPTIMUM (AFTER, YOUNGER AND LIM, 1969).

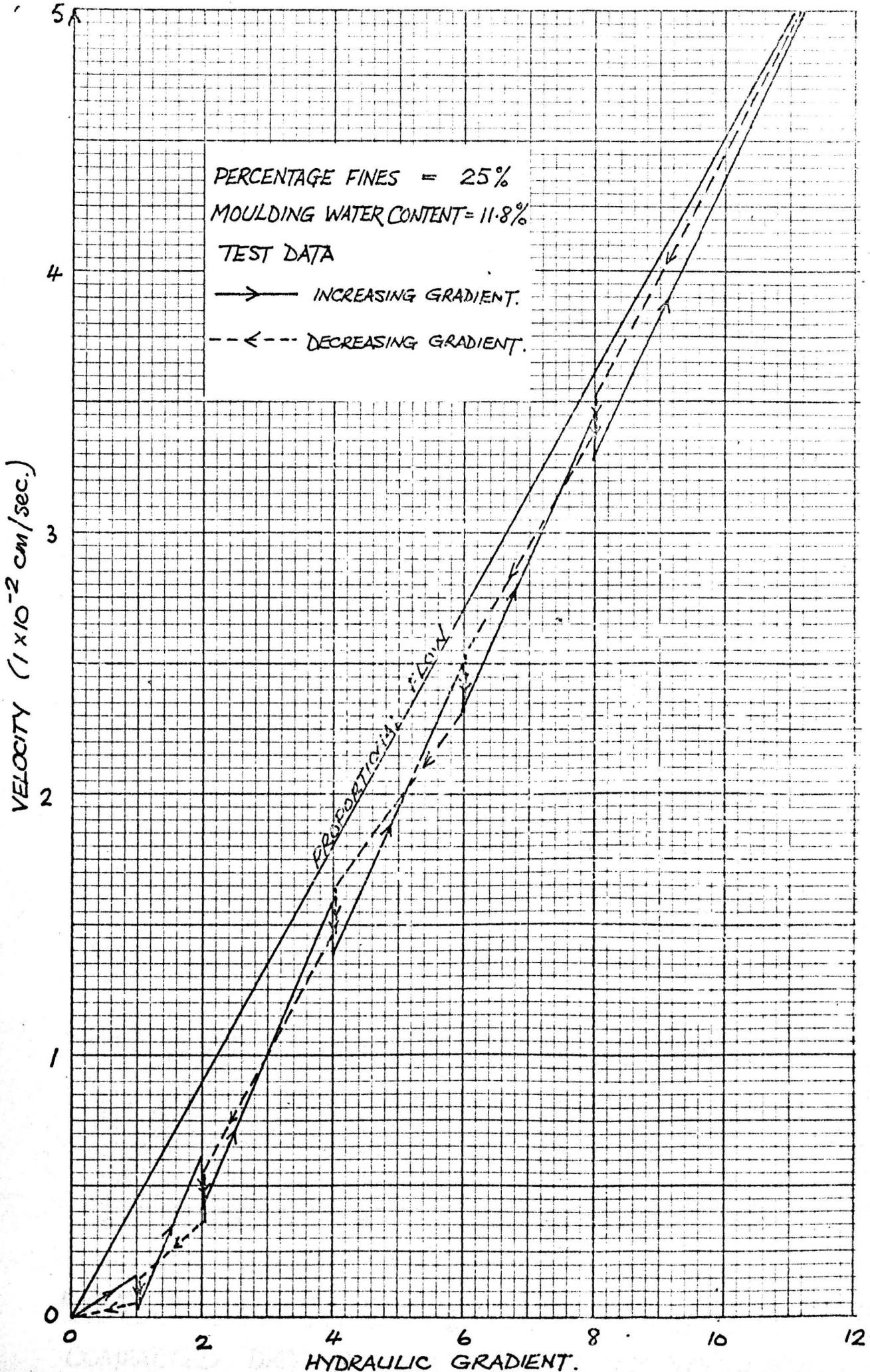


FIG.7.27. VELOCITY-GRADIENT PLOT FOR 25 PER CENT FINES COMPACTED DRY OF OPTIMUM (AFTER YOUNGER AND LIM, 1969)

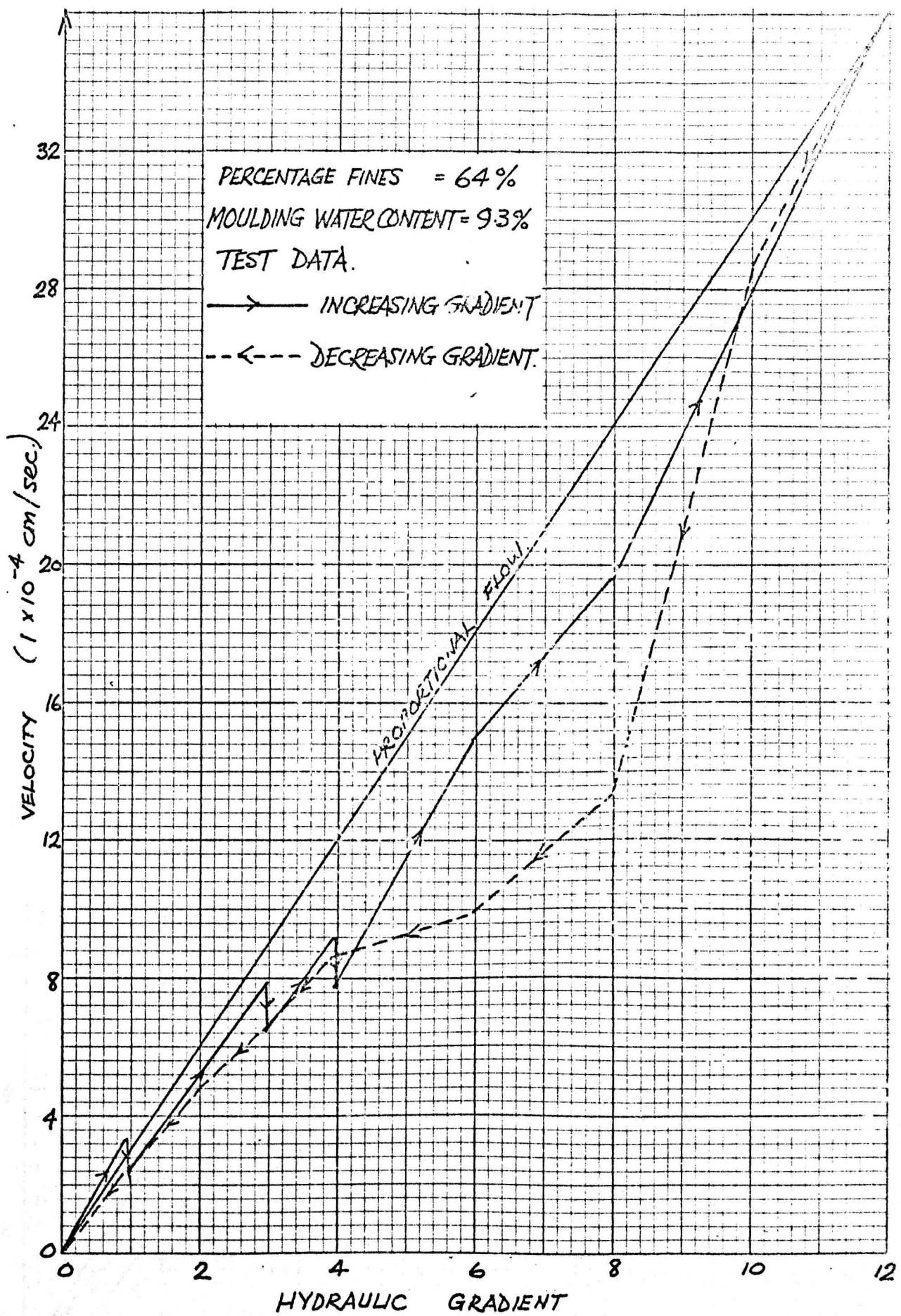


FIG. 7.28. VELOCITY-GRADIENT PLOT FOR 64 PER CENT FINES.

COMPACTED DRY OF OPTIMUM (AFTER YOUNGER AND LIM 1963)

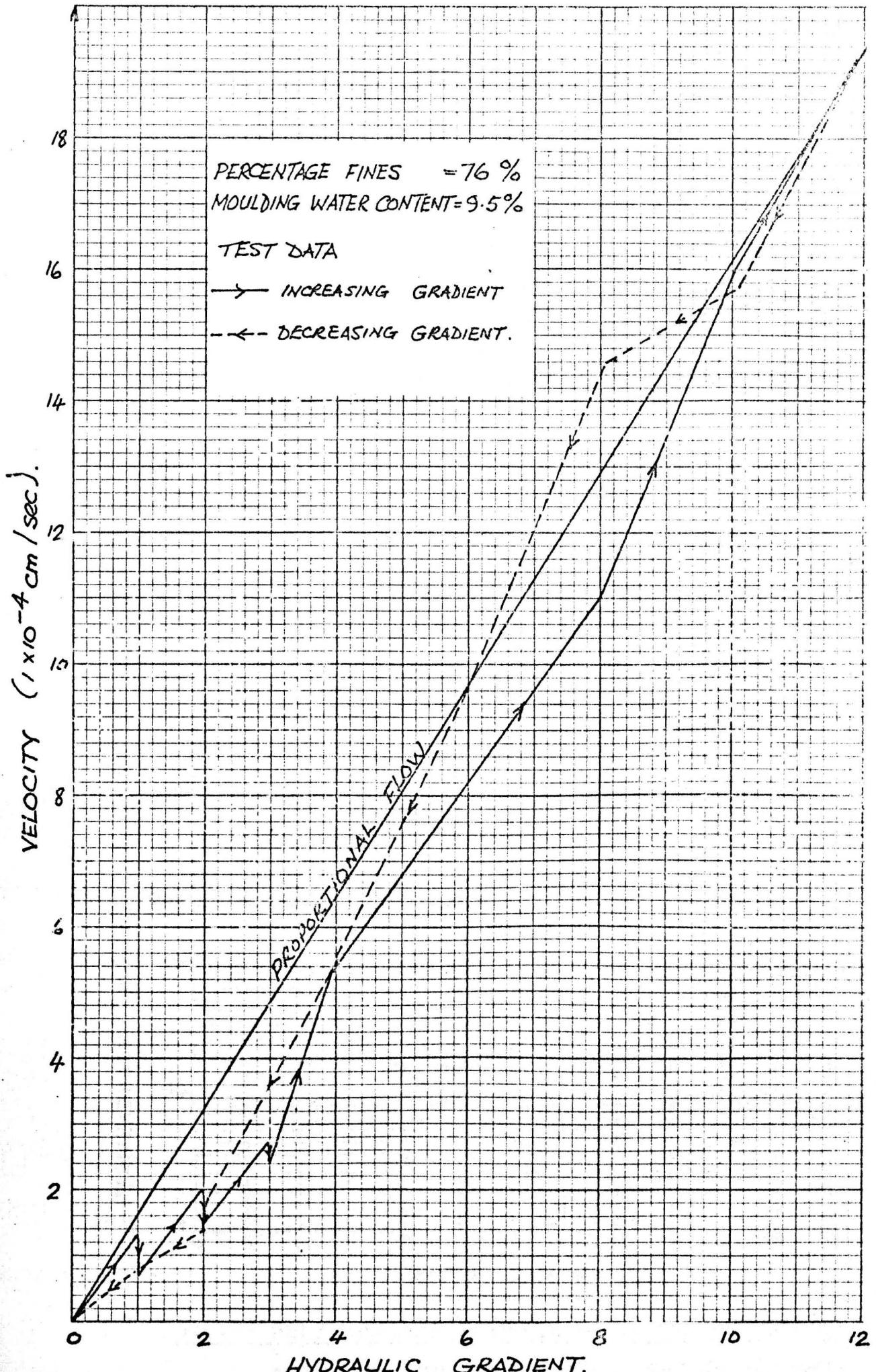


FIG. 7.29. VELOCITY GRADIENT PLOT FOR 76 PER CENT FINES COMPACTED DRY OF OPTIMUM (AFTER YOUNGER AND LIM, 1969).

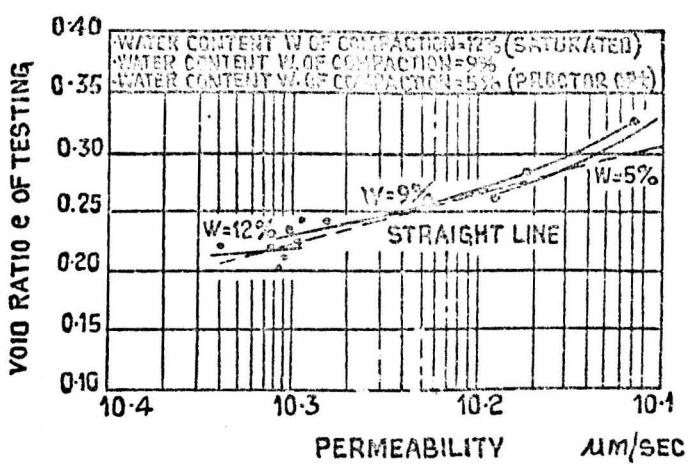


FIG 7.30 RELATION BETWEEN WATER CONTENT AT COMPACTION AND PERMEABILITY OF SANDY MORAINES (BERNELL, 1957.)

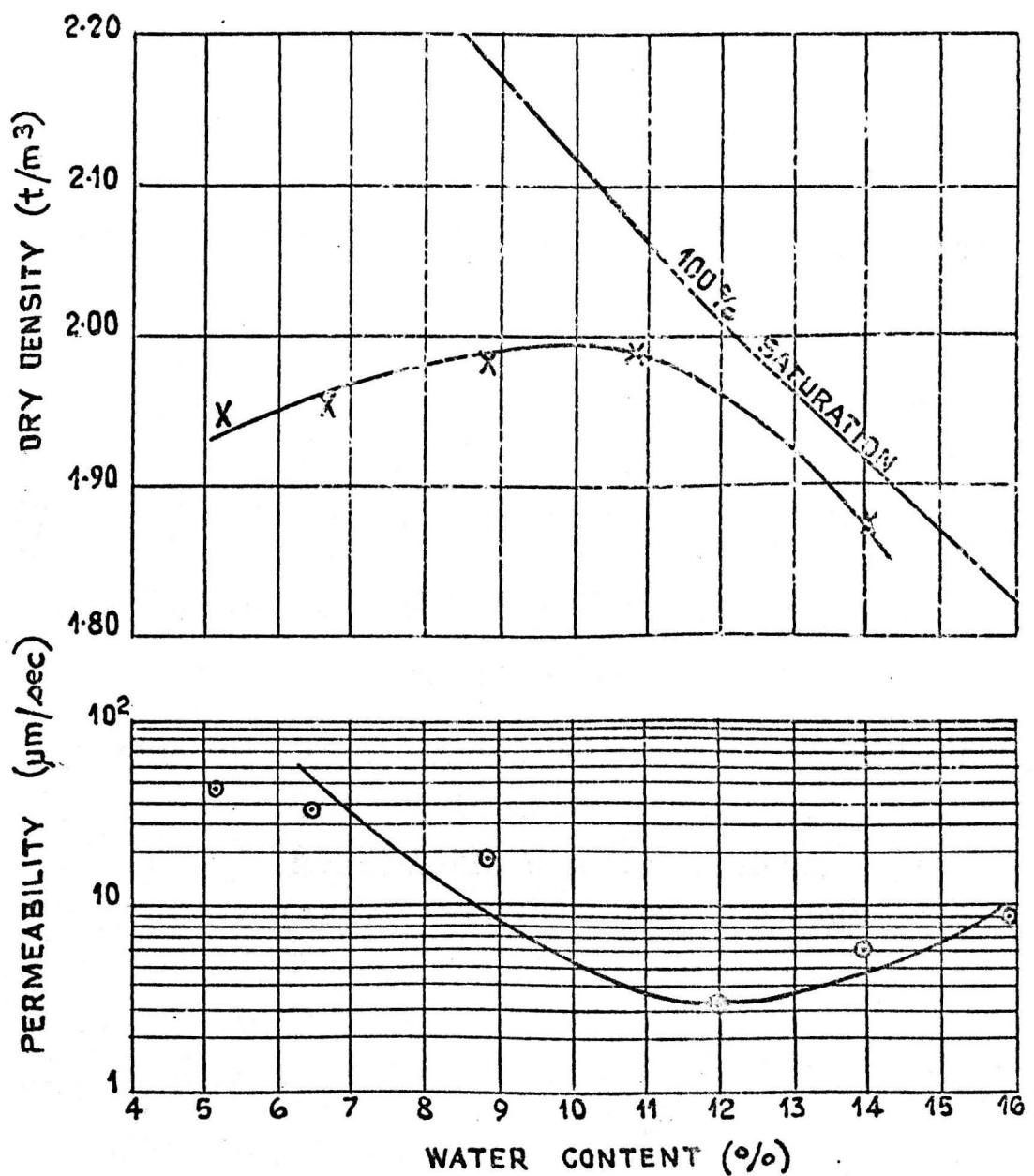
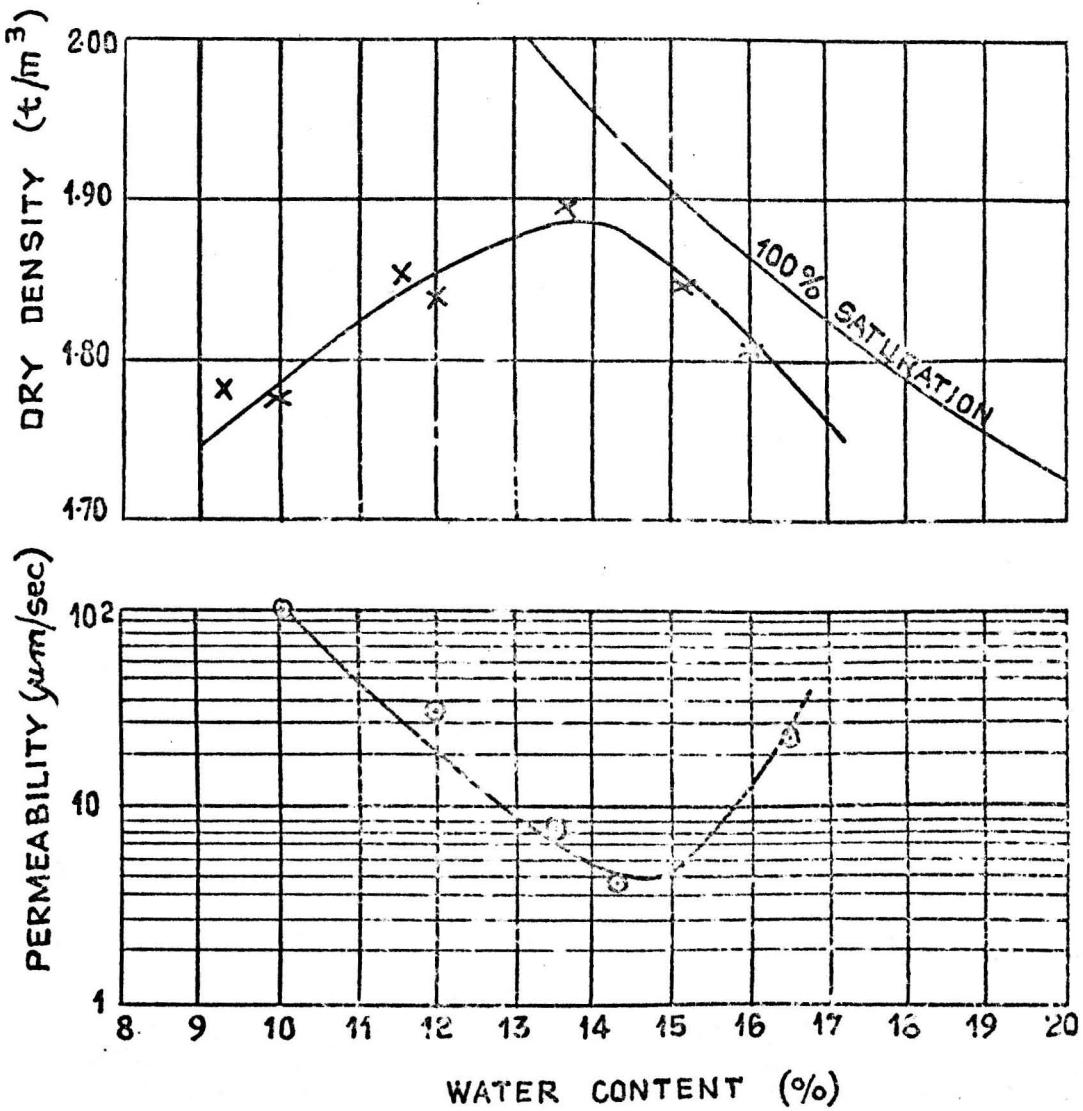
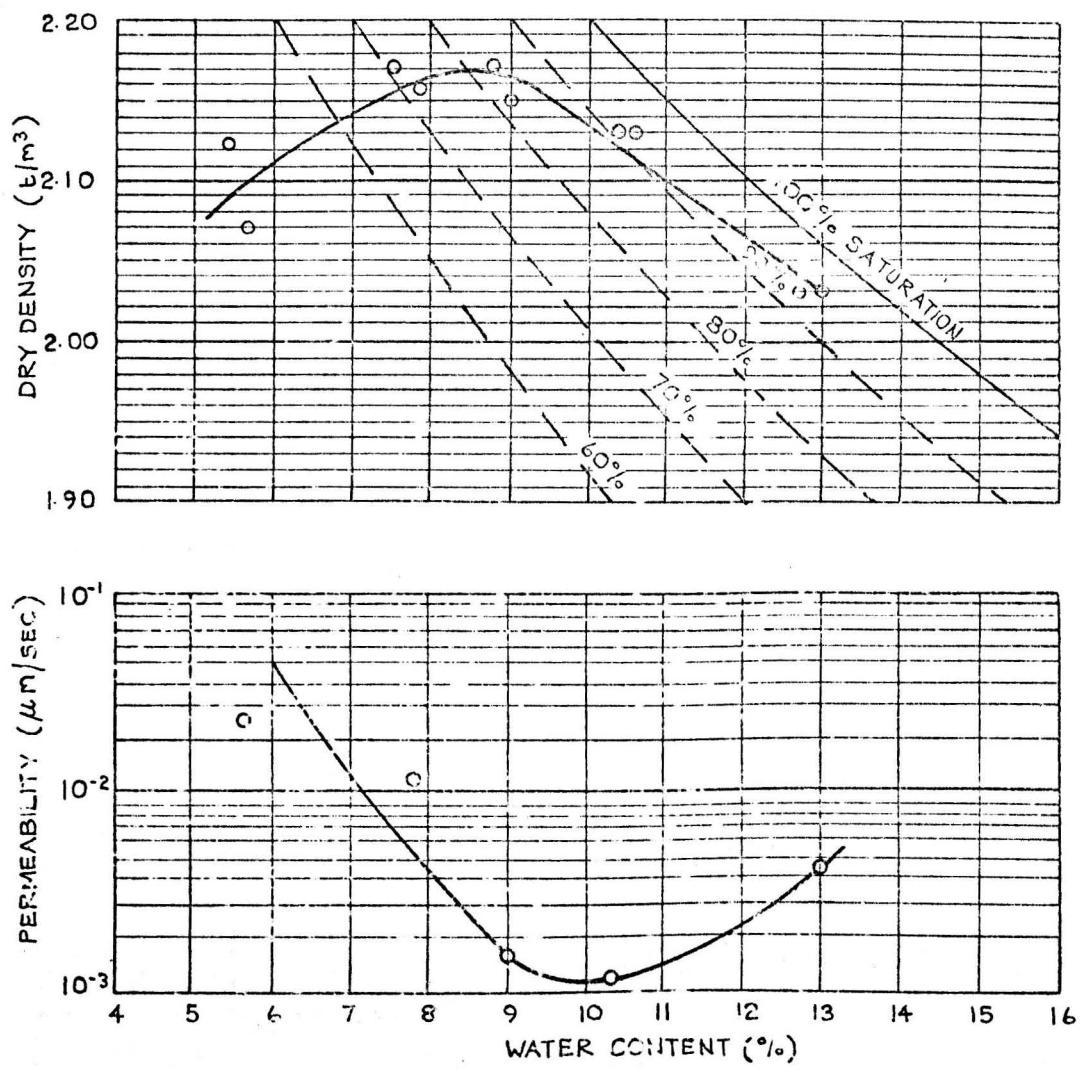


FIG.7.31. RELATIONSHIP BETWEEN WATER CONTENT DRY DENSITY AND PERMEABILITY FOR COWAL TILL (65% FINES)



**FIG 7.32 RELATIONSHIP BETWEEN WATER CONTENT,  
DRY DENSITY AND PERMEABILITY FOR  
BACKWATER TILL (46% FINES)  
(AFTER YOUNGER AND LIM, 1969.)**



**FIG. 7.33 RELATIONSHIP BETWEEN WATER CONTENT, DRY DENSITY AND PERMEABILITY FOR AKERSVATN DAM, NORWAY (SANDE, 1973)**

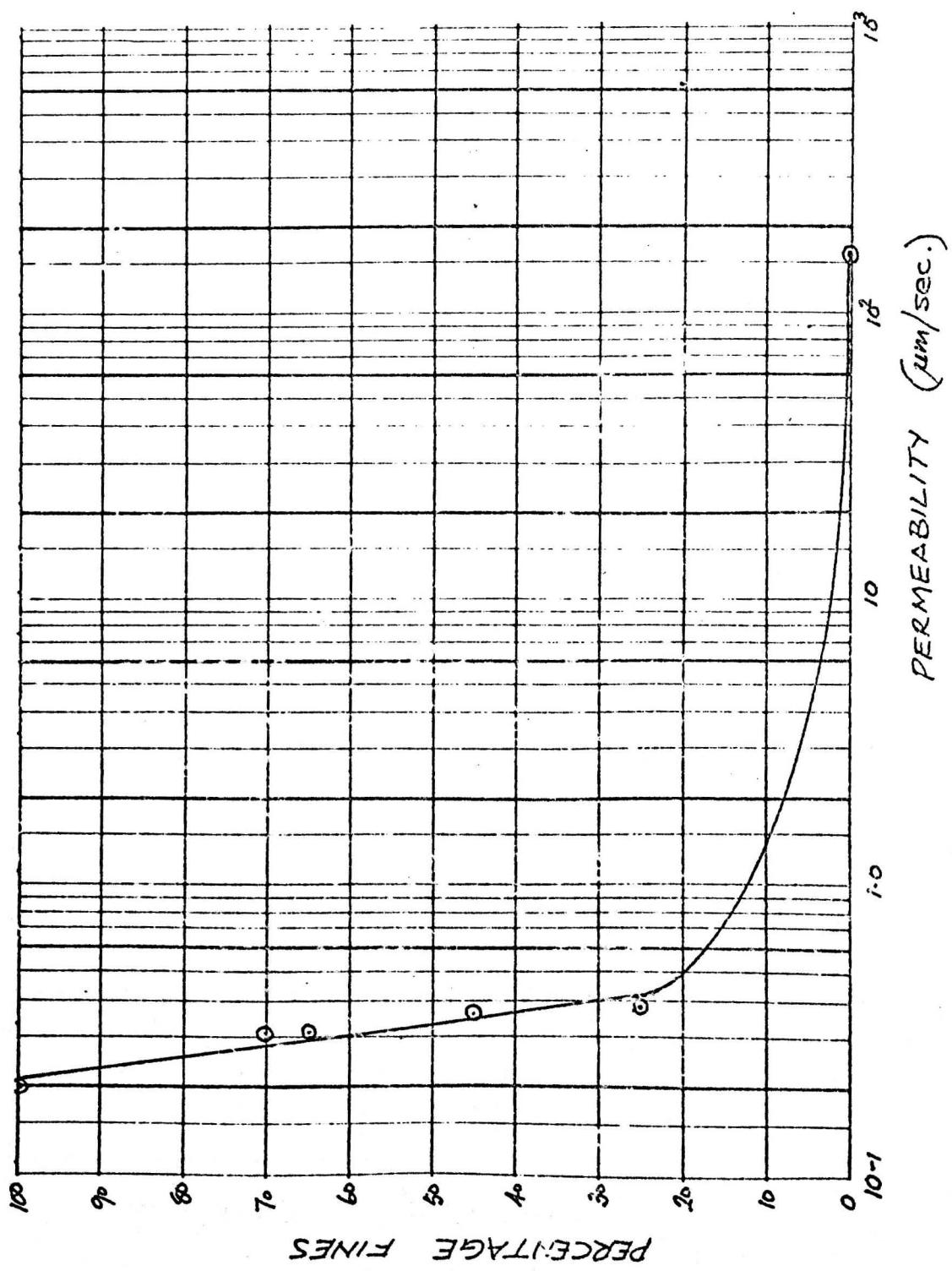


FIG. 7.34. RELATIONSHIP BETWEEN PERCENTAGE FINES  
AND PERMEABILITY FOR COWAL TILL.

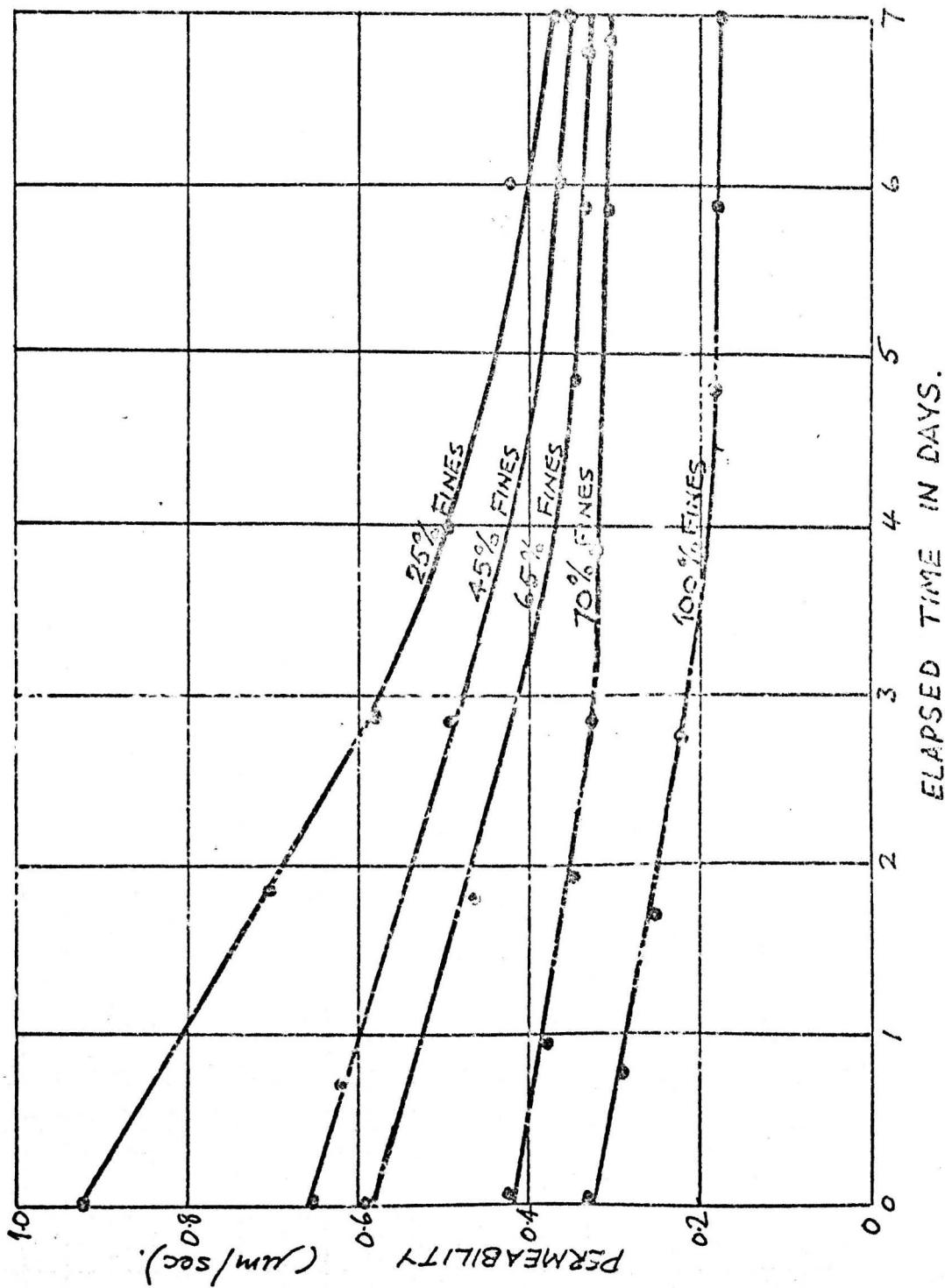


FIG. 7.35. PERMEABILITY-TIME VARIATIONS  
IN COWAL TILL

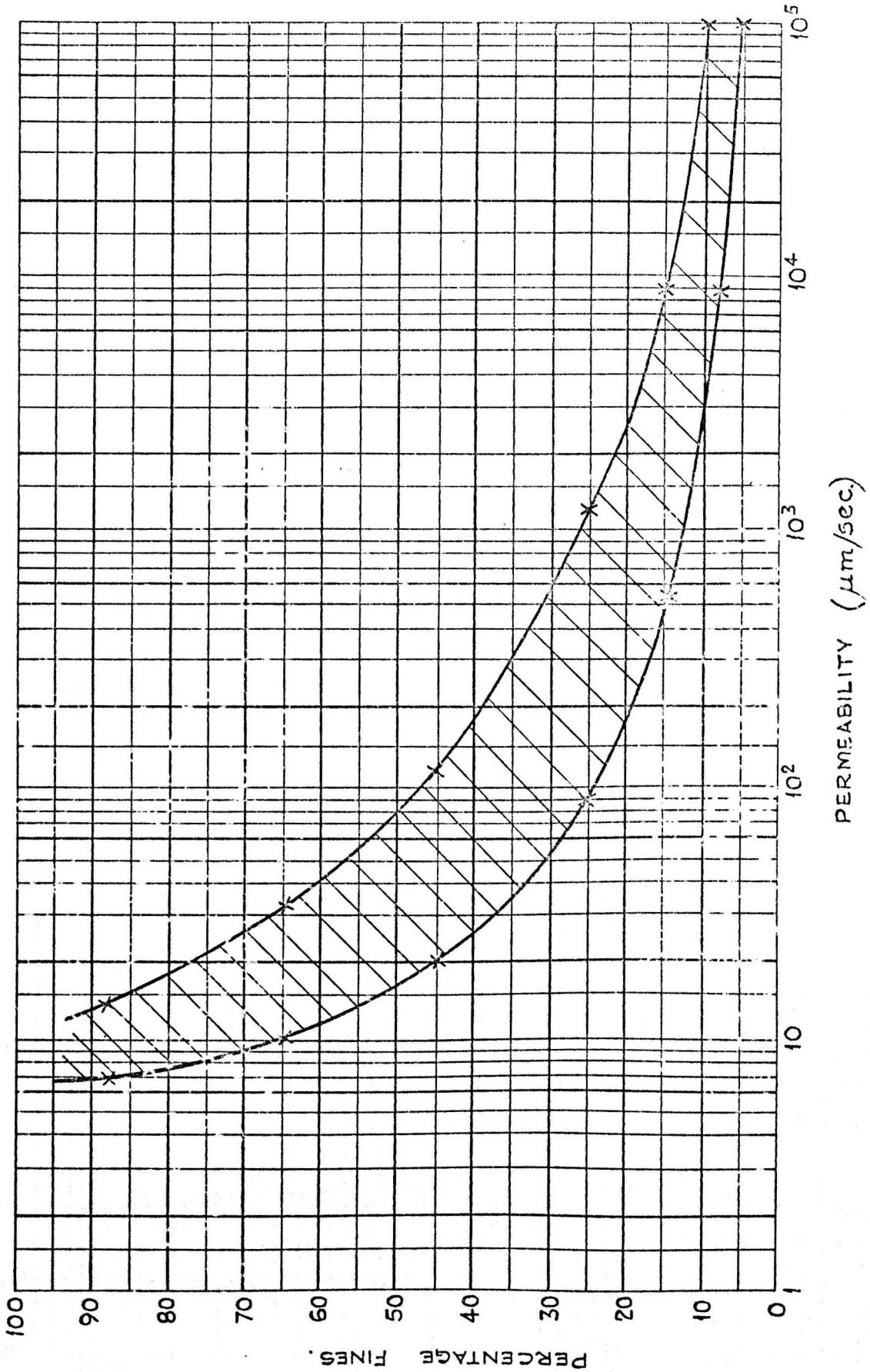


FIG. 7.36. FULL RANGE OF PERMEABILITY PERCENTAGE  
FINES RELATIONSHIP FOR BACKWATER TILLS  
TESTED BY YOUNGER AND LIM (1969).

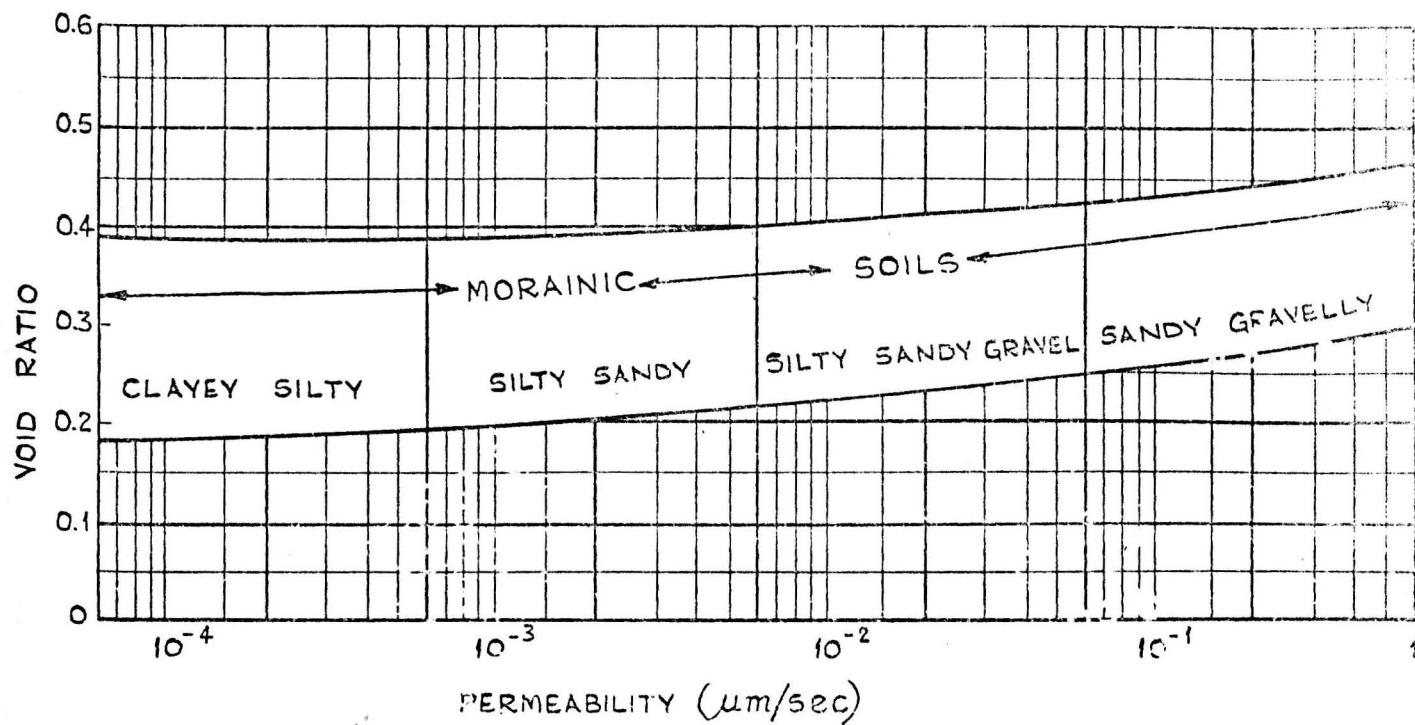


FIG. 7.37 RELATION BETWEEN VOID RATIO AND PERMEABILITY OF MORAINIC SOILS (AFTER BERNELL, 1957)

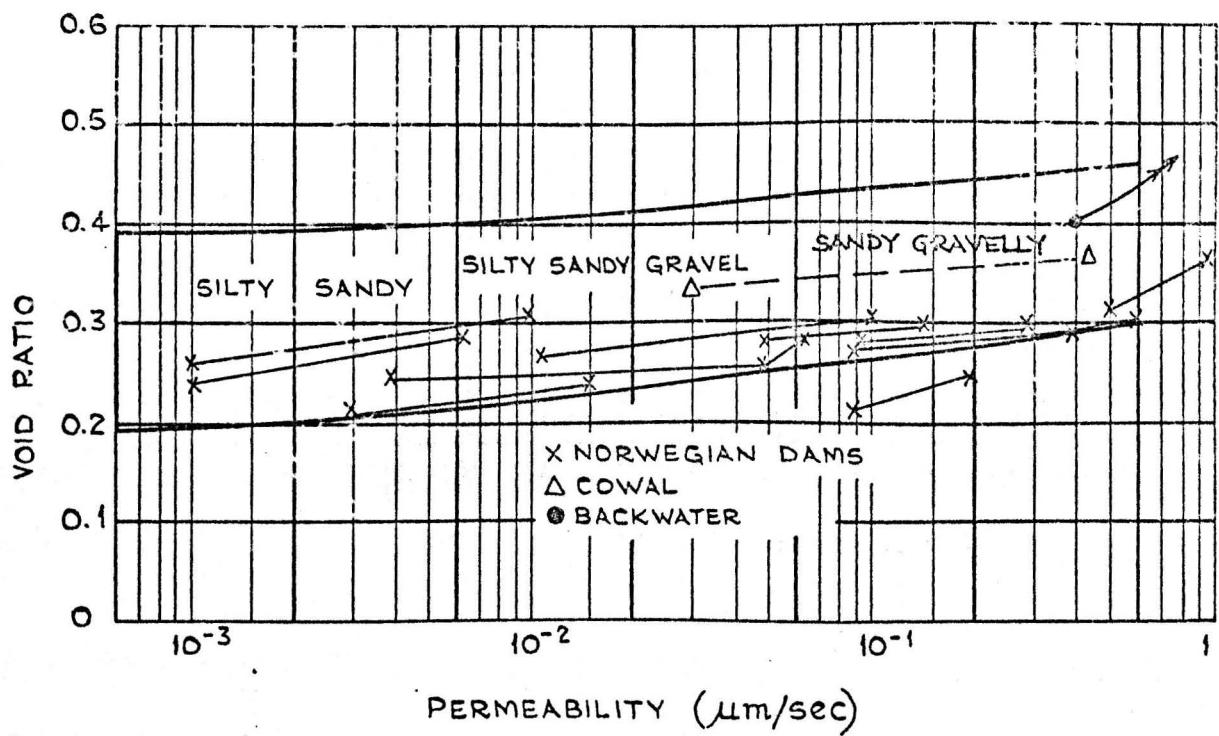
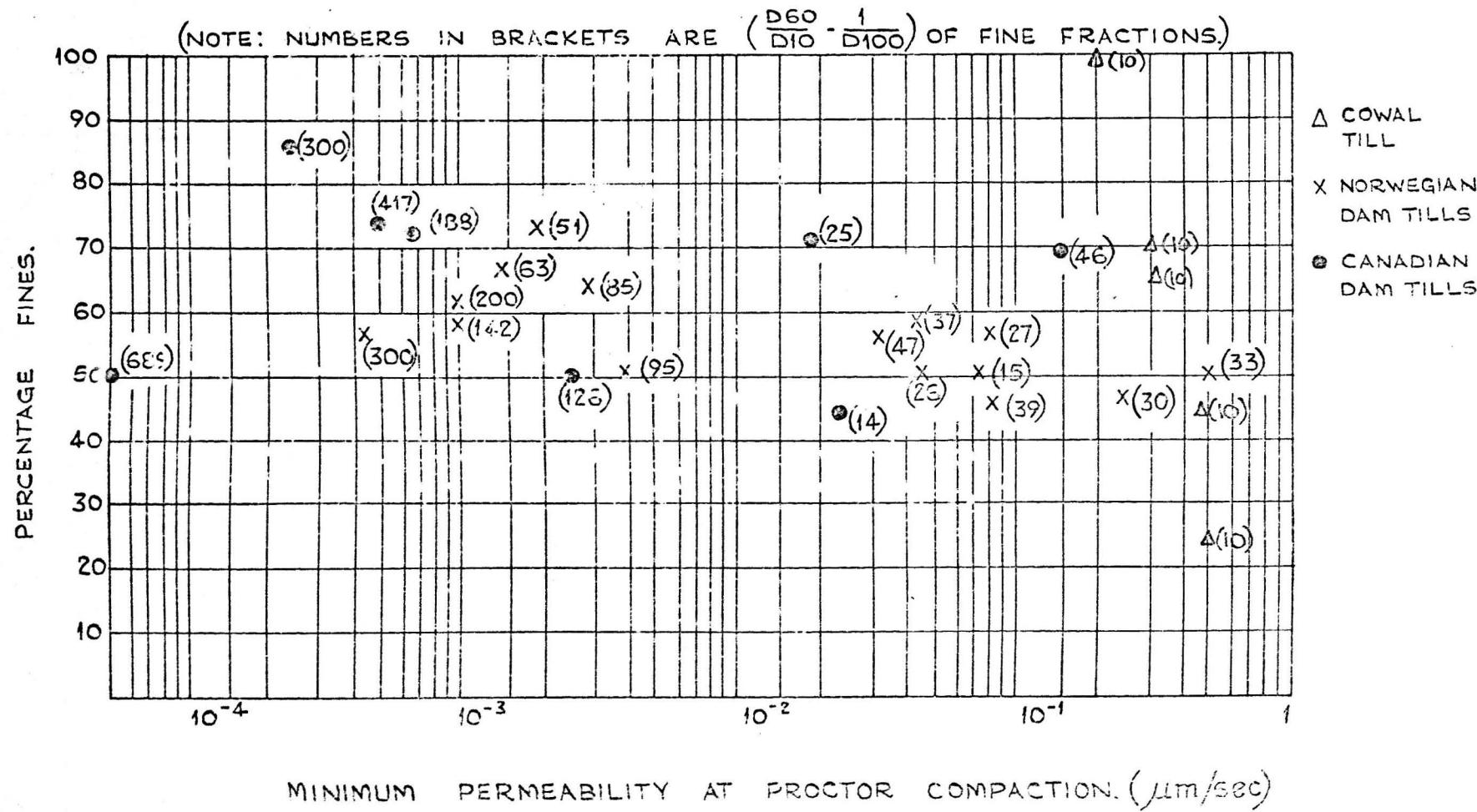


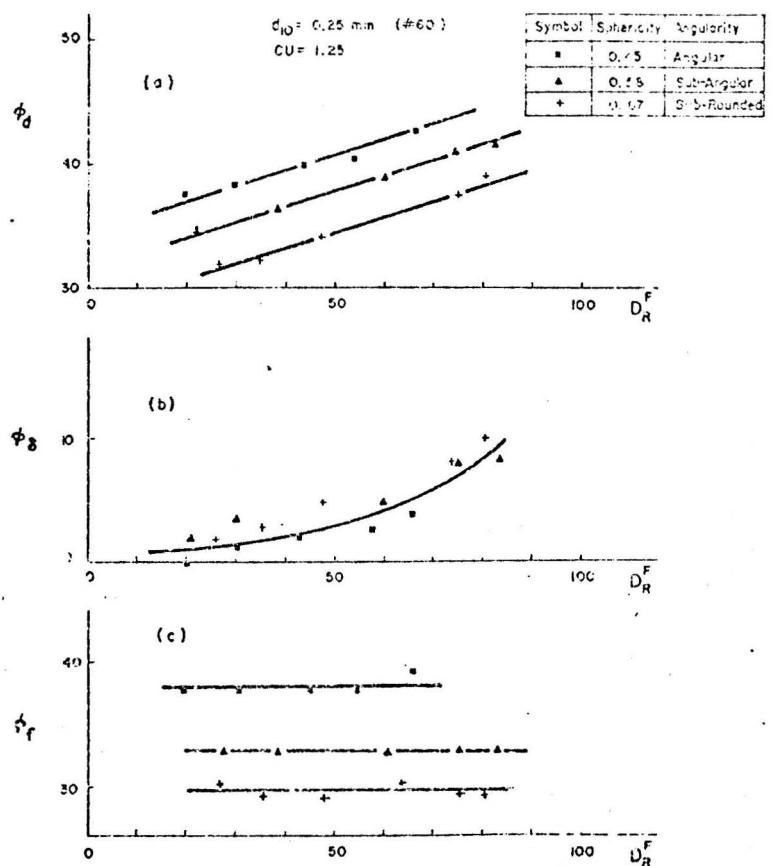
FIG. 7.38 RELATIONSHIP BETWEEN VOID RATIO AND PERMEABILITY FOR VARIOUS TILLS.

FIG. 7.39.

## PERMEABILITY AT PROCTOR COMPACTION FOR



## SATURATED QUARTZ



RELATIVE DENSITY AT FAILURE.

Fig. 7.40 THE EFFECT OF PARTICLE SHAPE,  
(KOERNER 1970a).

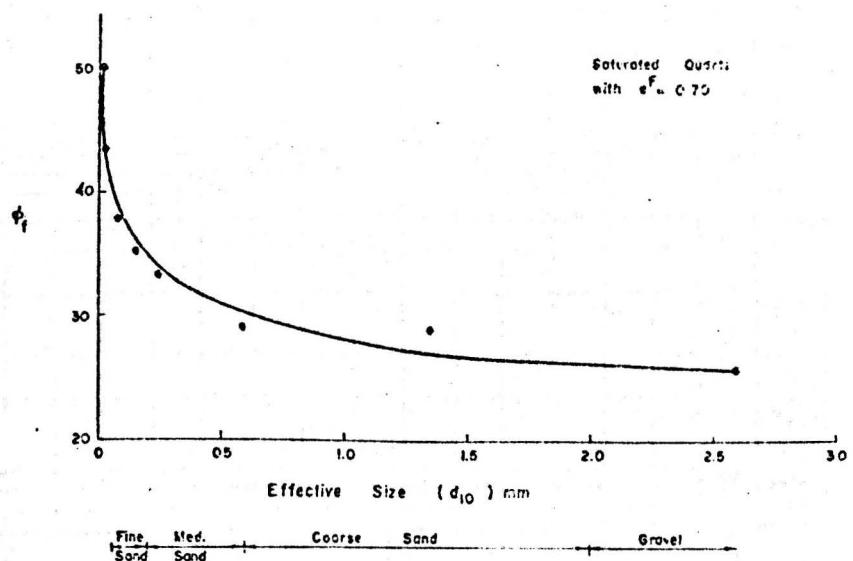


Fig. 7.41. THE EFFECT OF PARTICLE SIZE

(KOERNER 1970a)

PARTICLE SIZE DISTRIBUTION  
SEMI-LOG PLOT

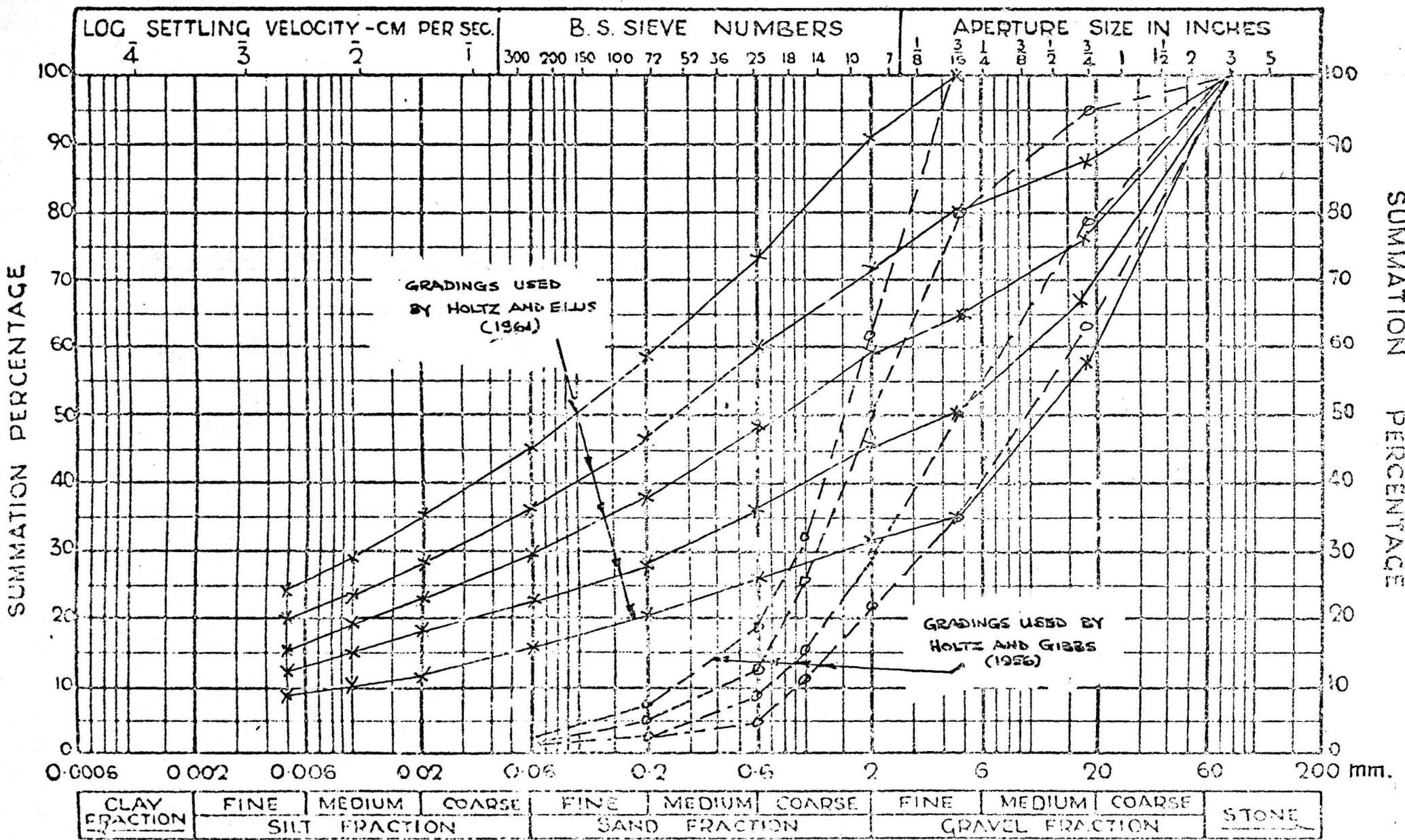
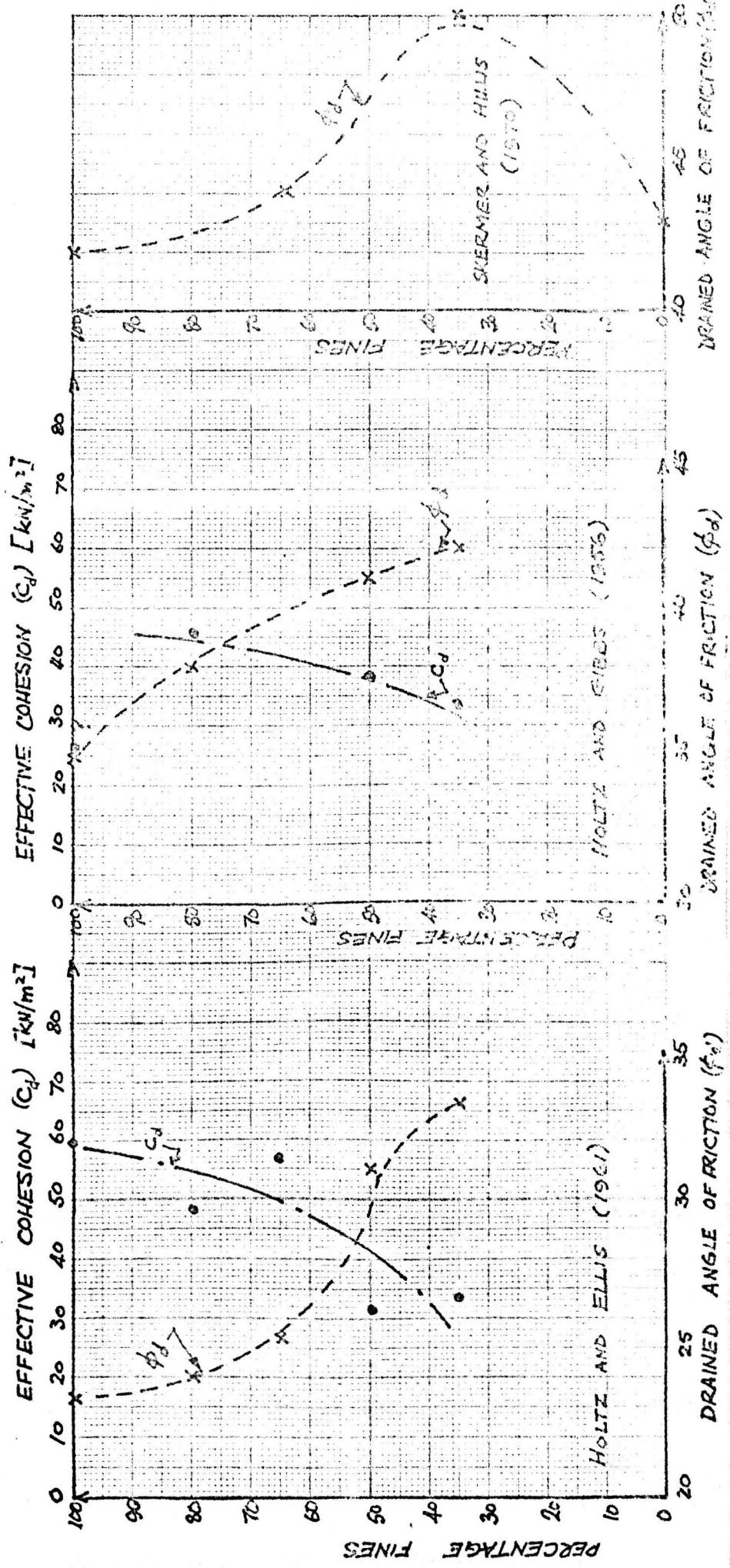


FIG. 7.42. GRADINGS USED BY HOLTZ AND GIBBS (1956) AND HOLTZ AND ELLIS (1961).

FIG. 7.43. SHEAR STRENGTH - GRADATIONAL RELATIONSHIP FOR SOME SOIL MIXTURES.



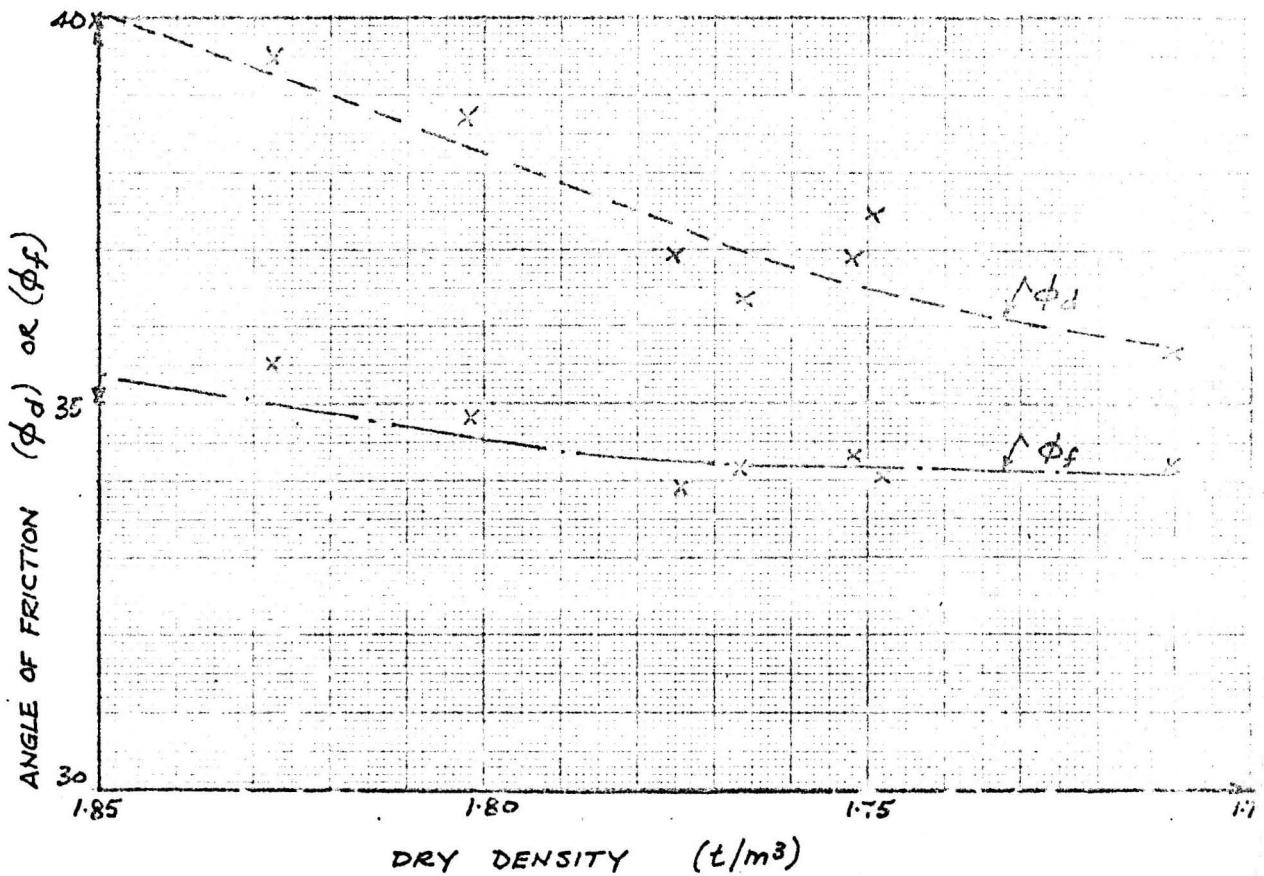


FIG. 7.44. DRY DENSITY-SHEAR STRENGTH PLOT FOR COWAL TILL.

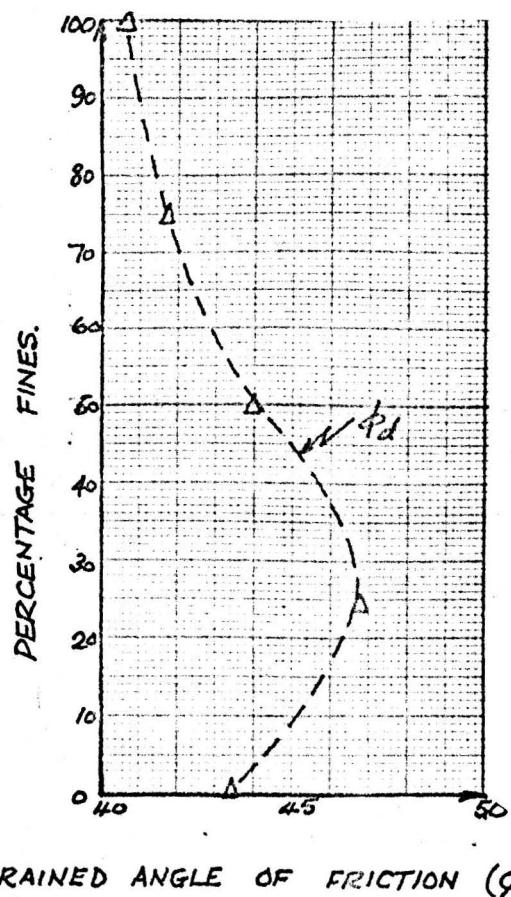
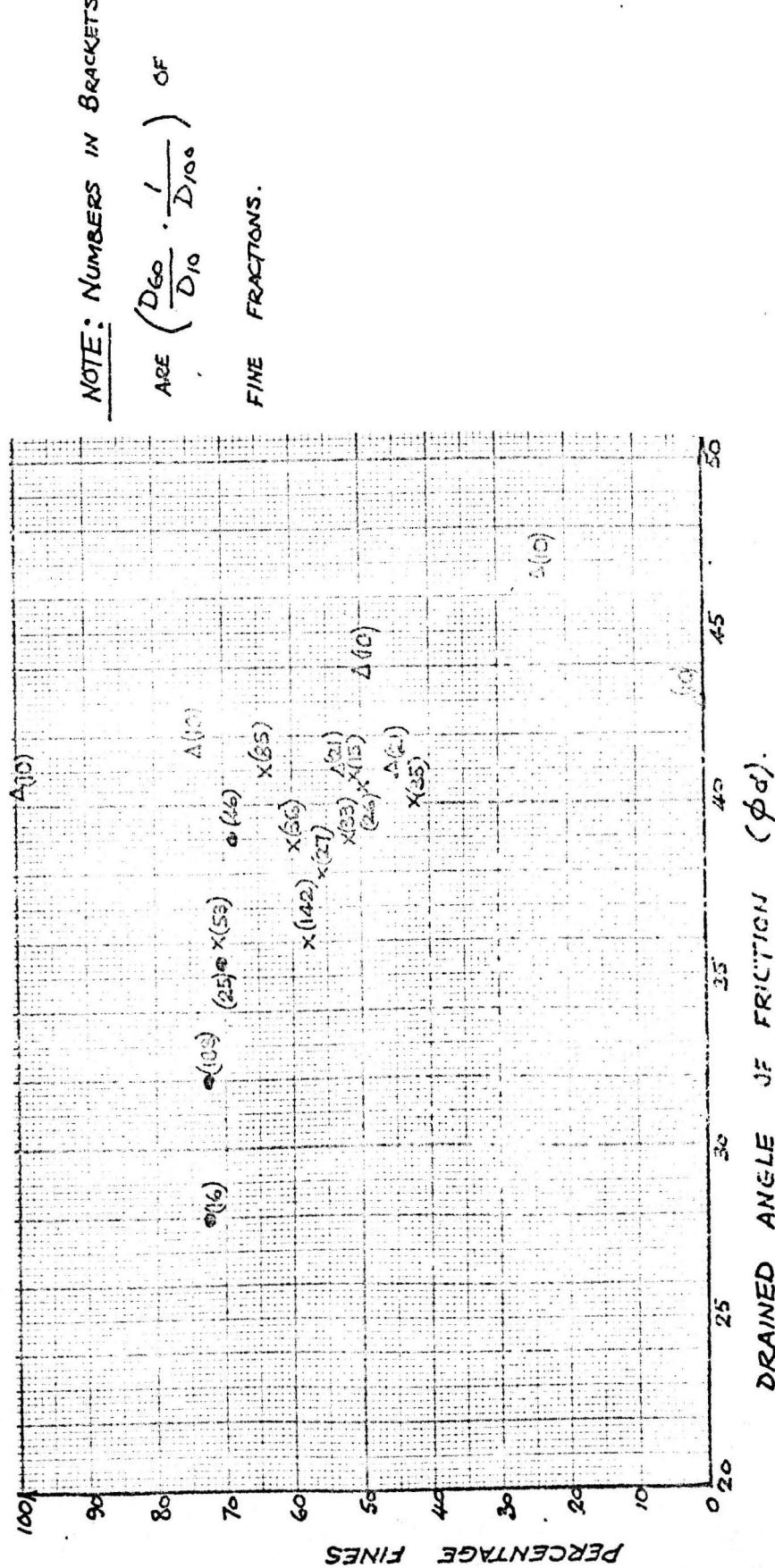


FIG. 7.45 PERCENTAGE FINES-SHEAR STRENGTH PLOT FOR COWAL TILL.

FIG. 7.46. PERCENTAGE FINES - SHEAR STRENGTH RELATIONSHIP FOR SOME TILLS.



PLATES

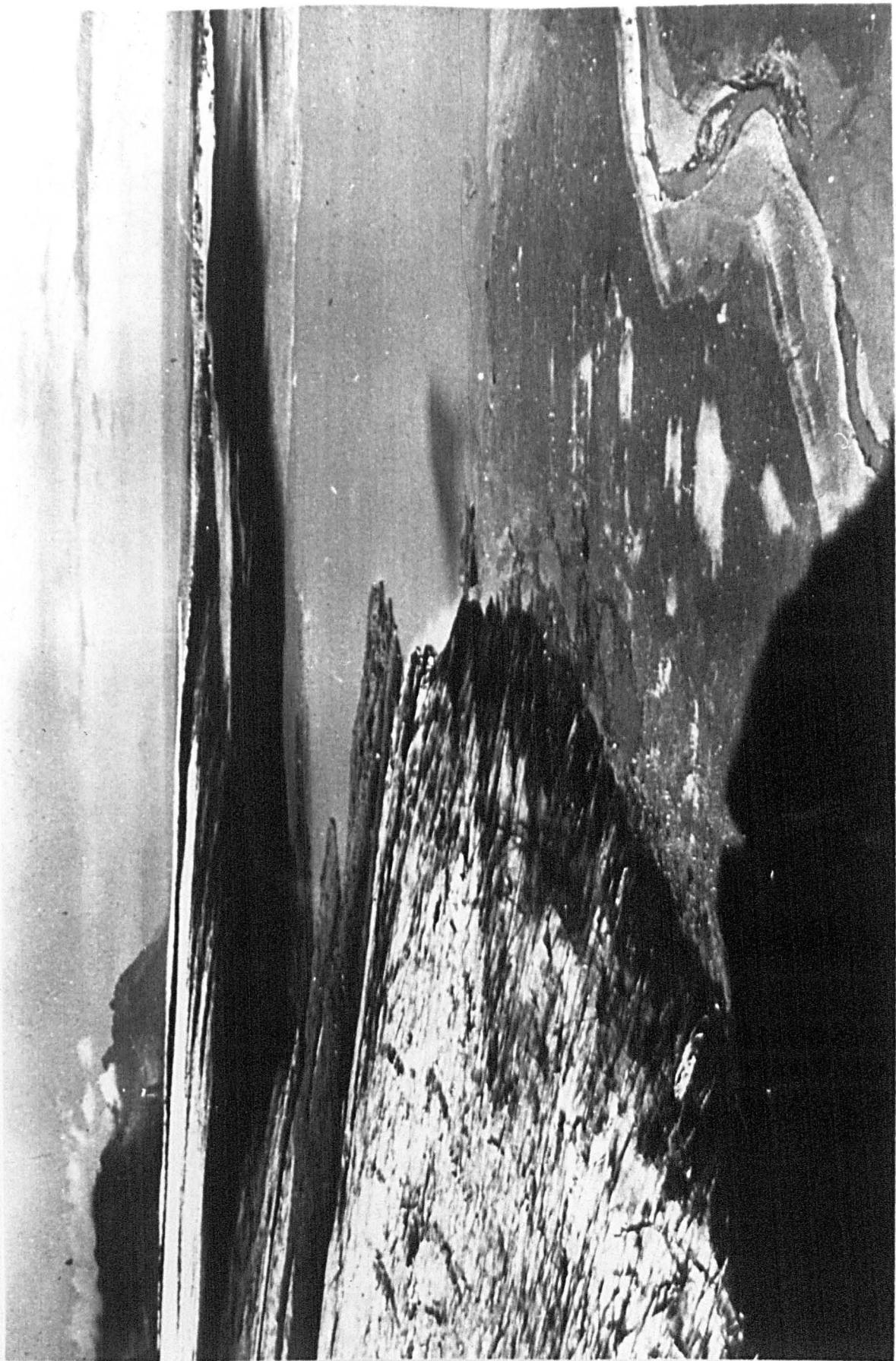


PLATE 4:1 VIEW OF BREIDA MERKURJOKULL AND BREIDA MERKUSANDUR,  
SOUTH EAST ICELAND.

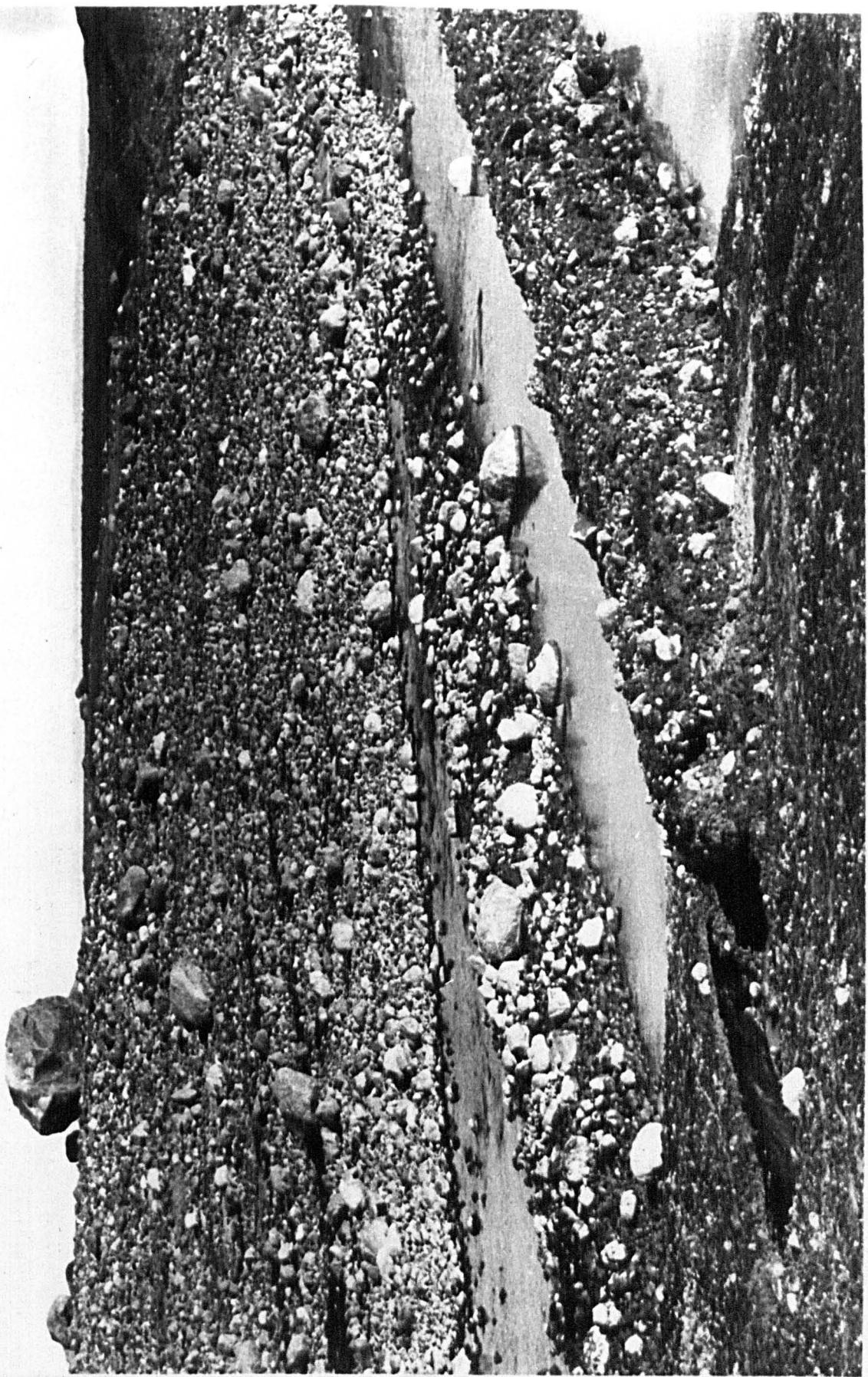


PLATE 4.2 FLUTED TILL, CENTRAL BREIDA, SHOWING FLUTE ENTERING  
SUBGLACIAL GROOVE (FOREGROUND).

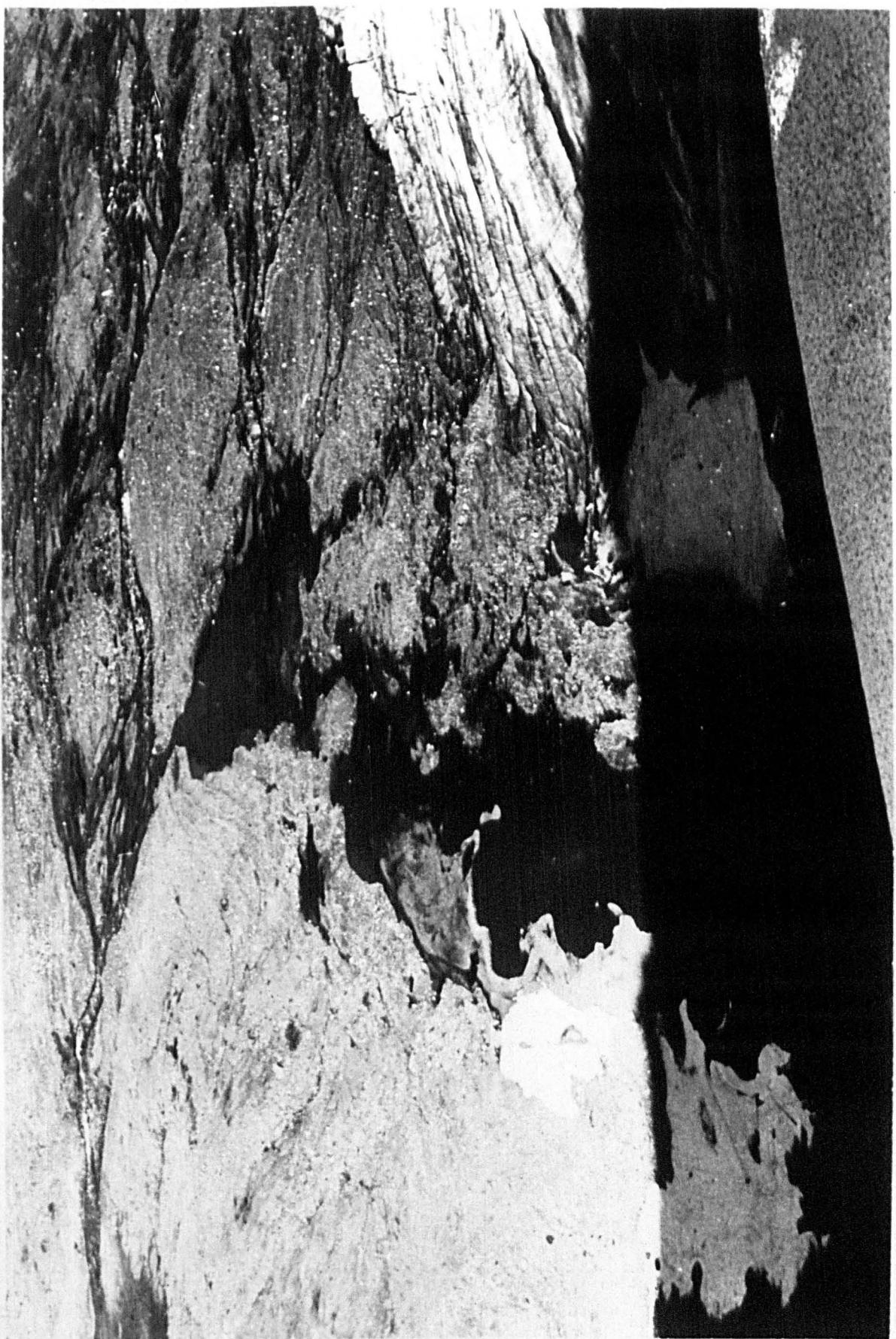


PLATE 4.3 PROGLACIAL AREA OF BLAISEN, SOUTHERN NORWAY.

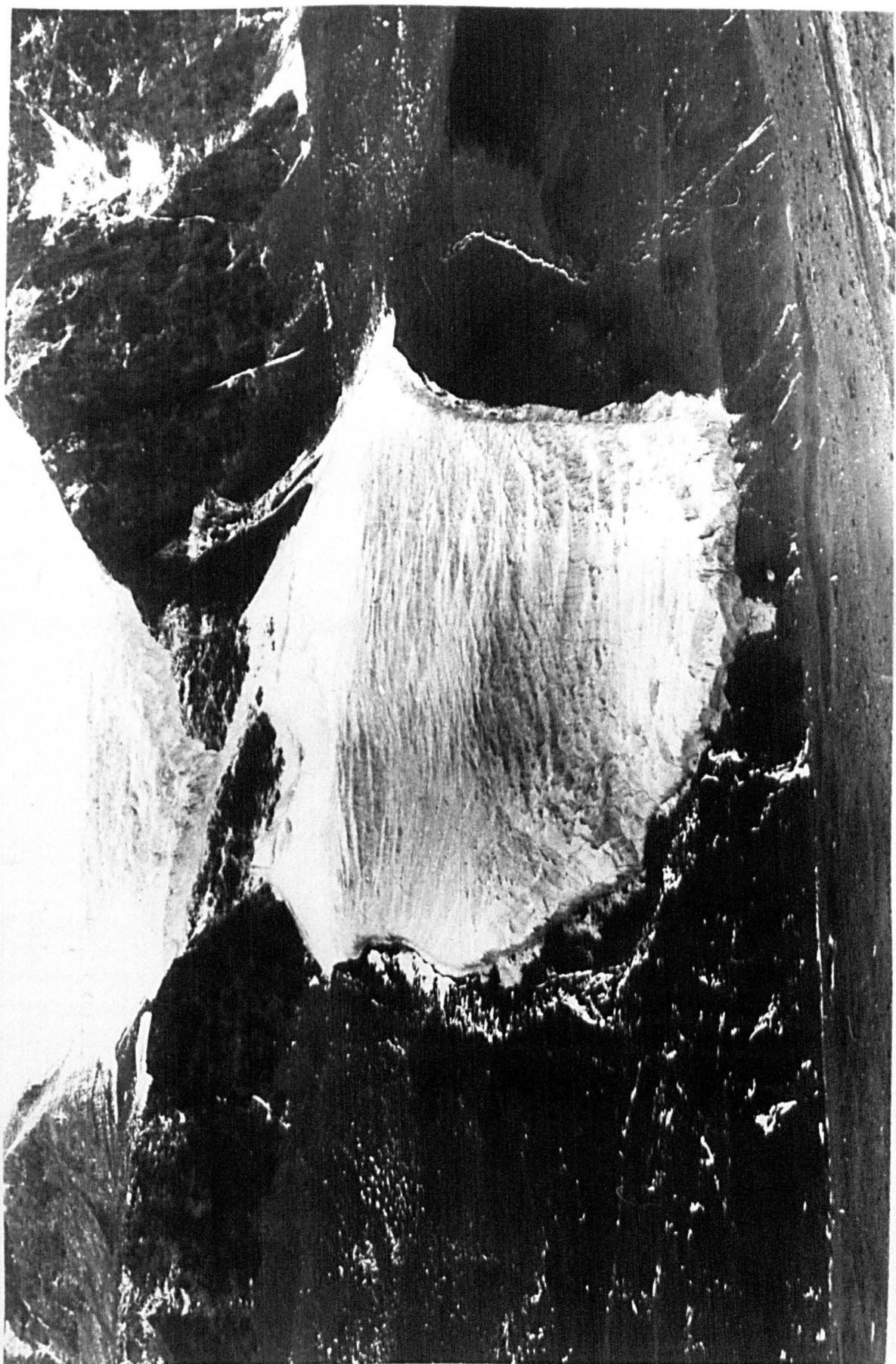


PLATE 4.4 VIEW OF LACROIX GLACIER, TAYLOR VALLEY, ANTARCTICA.

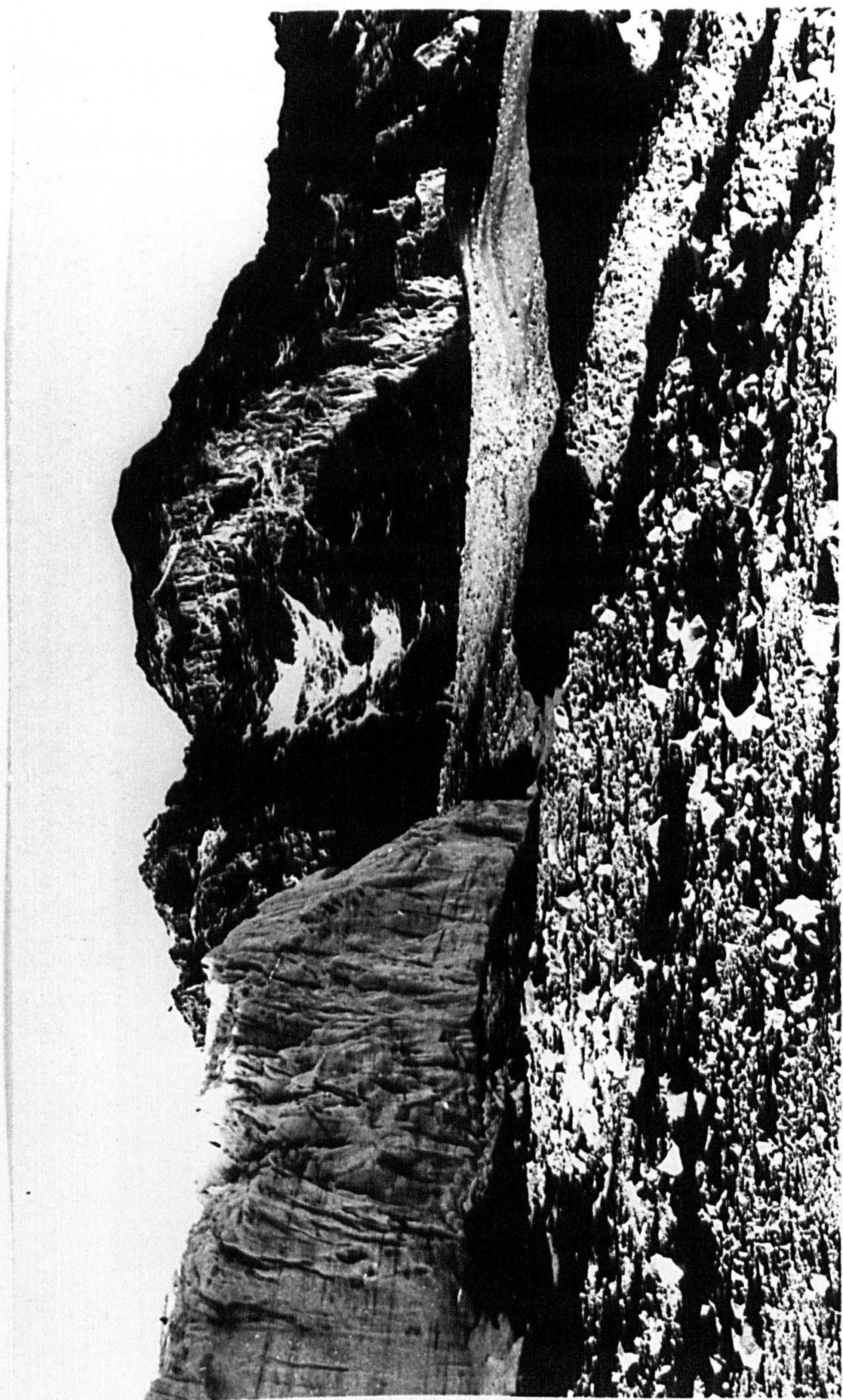


PLATE 4.5 EAST EDGE OF SNOOT OF LACROIX GLACIER, VIEW TOWARDS N.N.W.

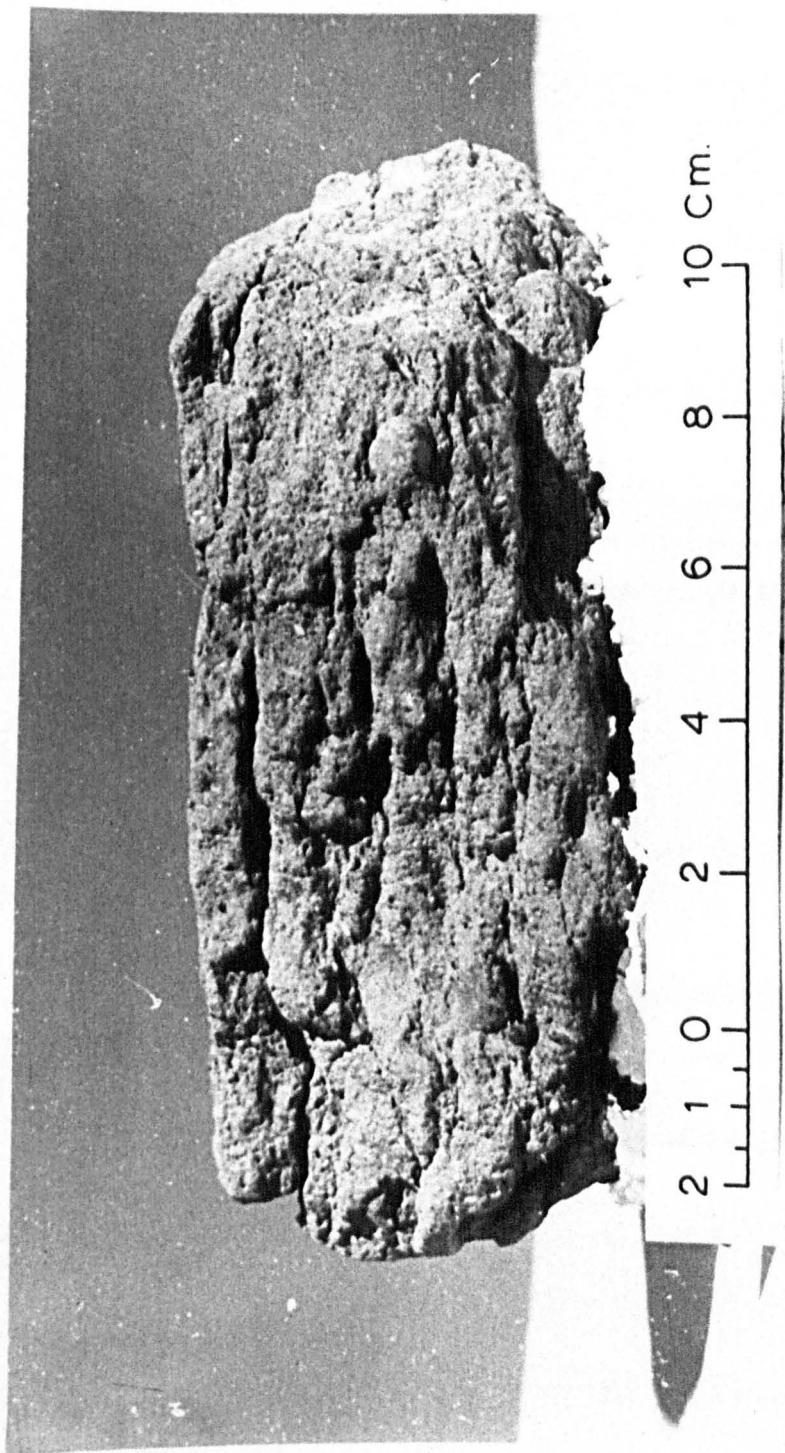
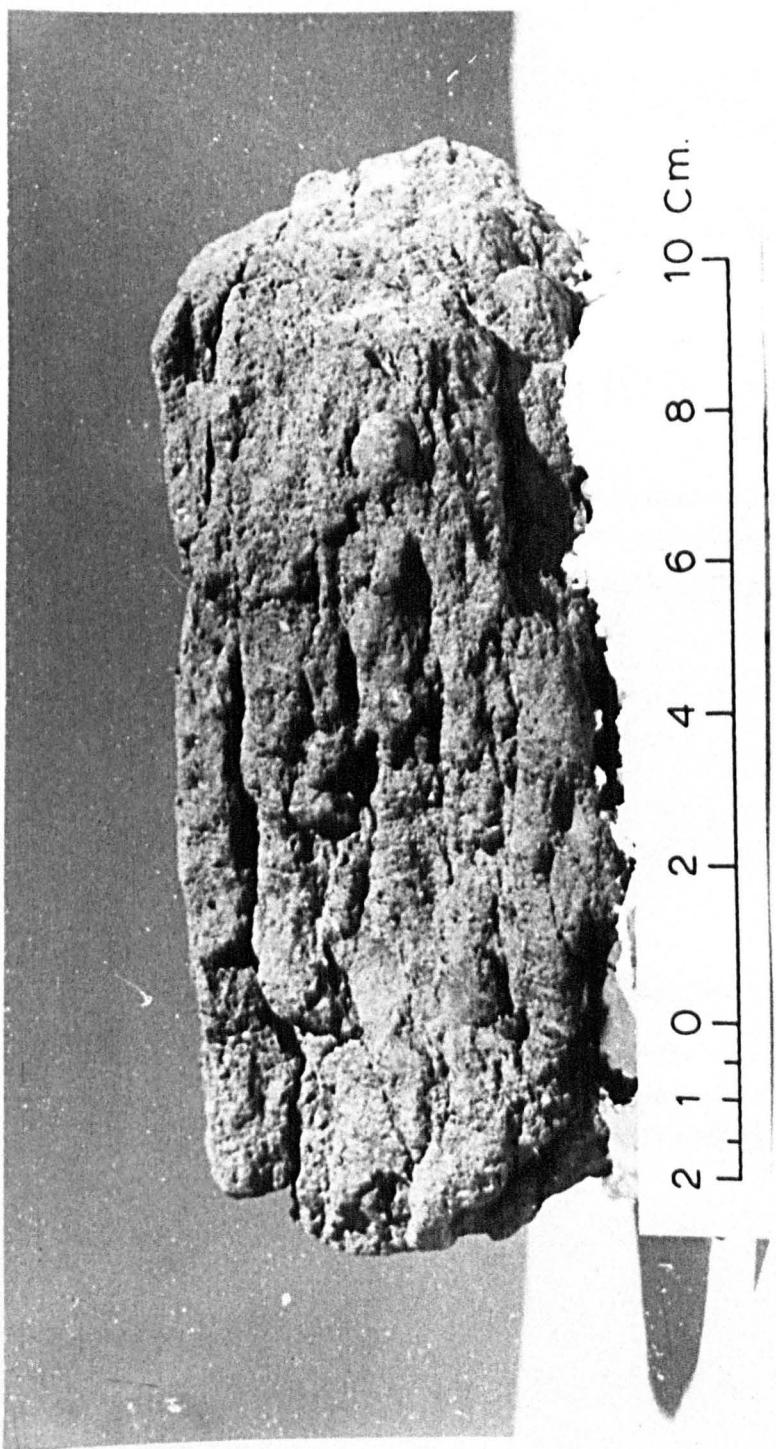


PLATE 4.5 ANTARCTIC TILL, ORIENTATED SAMPLE, VIEWING SOUTH

PLATE 4.5 ANTARCTIC TILL, ORIENTATED SAMPLE, VIEWING SOUTH



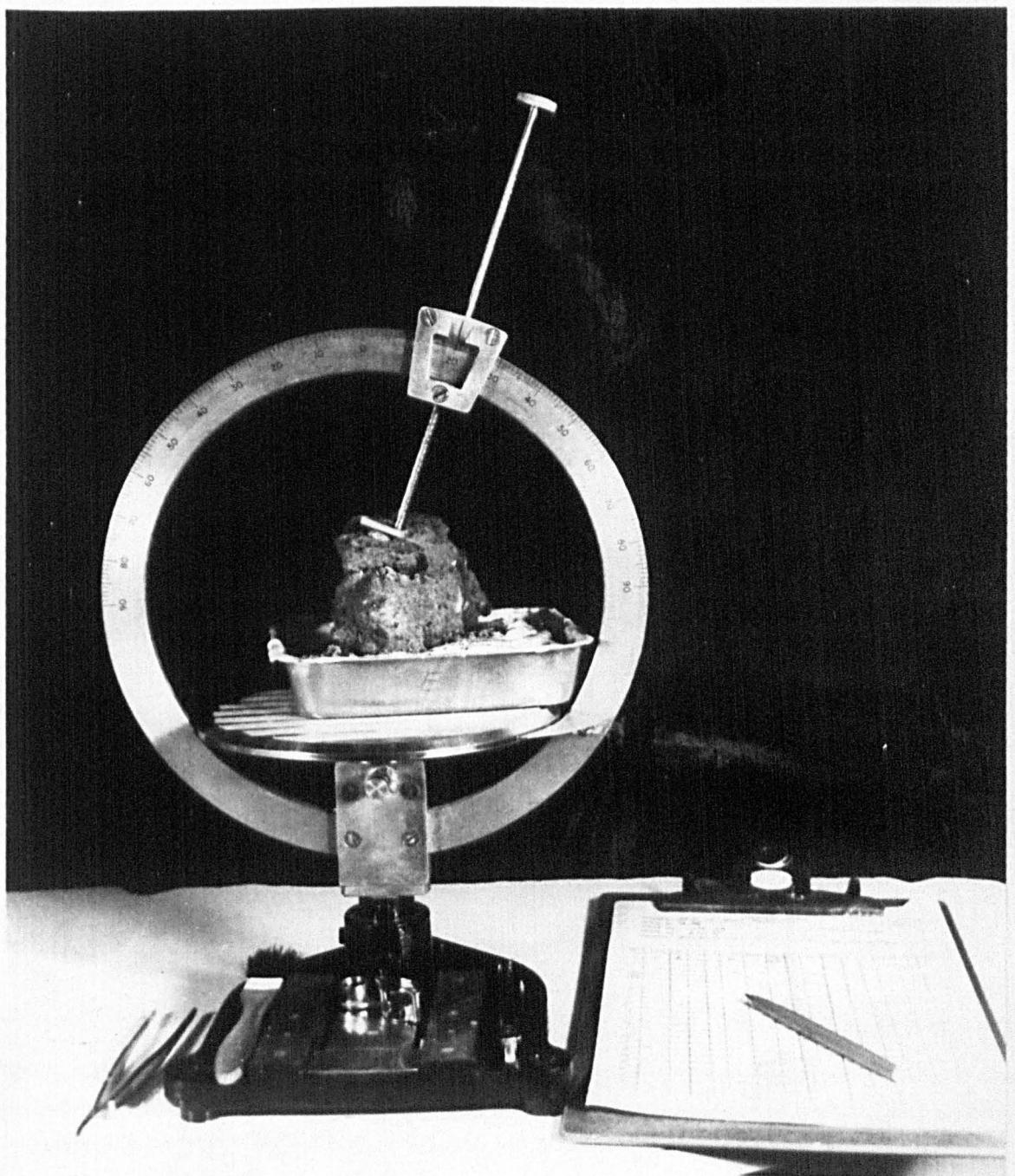


PLATE 6.1 THE LIGHTWEIGHT CONTACT GONIOMETER

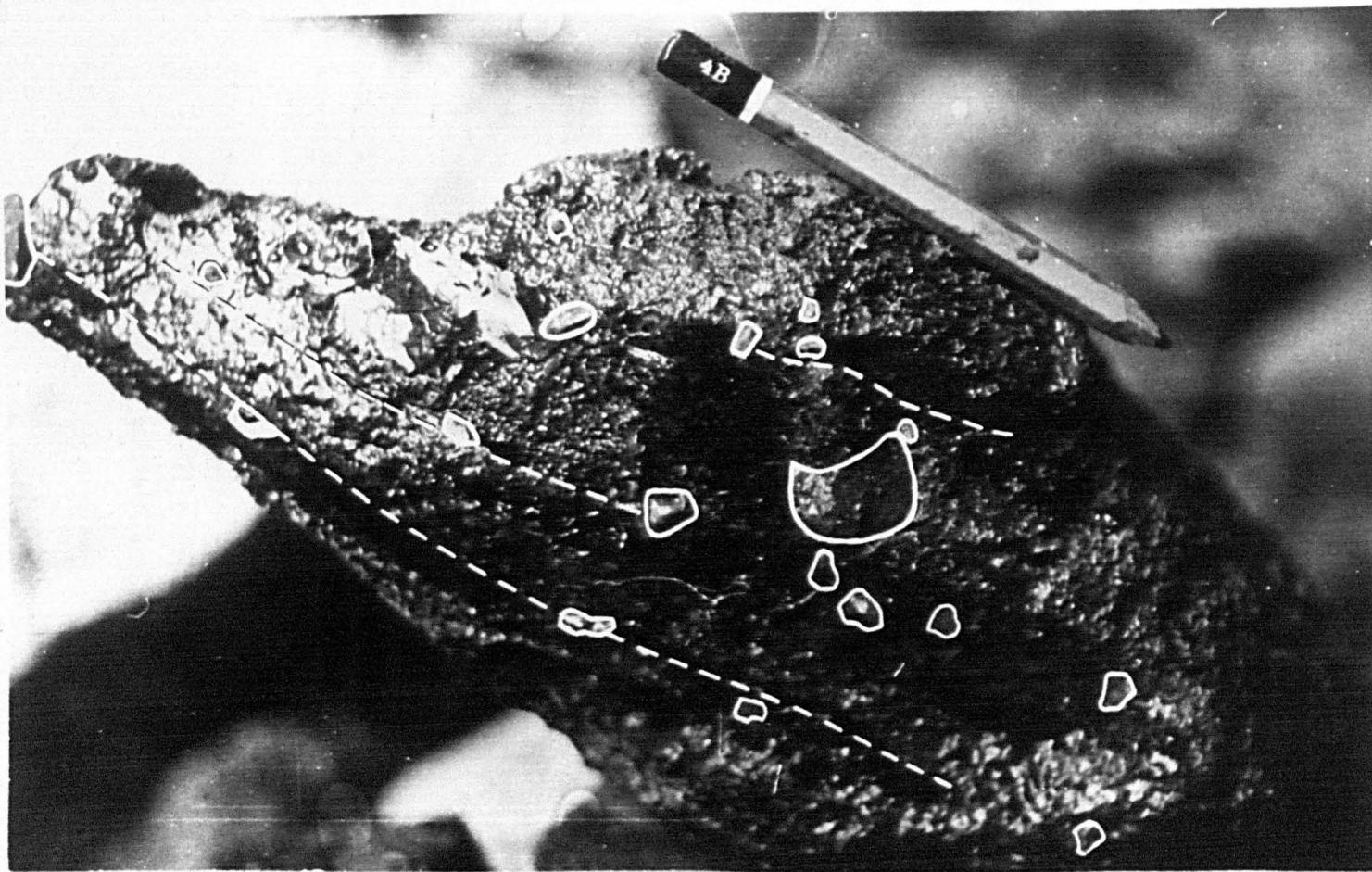


PLATE 6.2 BLOCK OF MELT DEBRIS-RICH ICE WITH CLASTS BEGINNING TO EMERGE.

(Note: Emerging clasts are circled and ice foliations are chain dotted.)

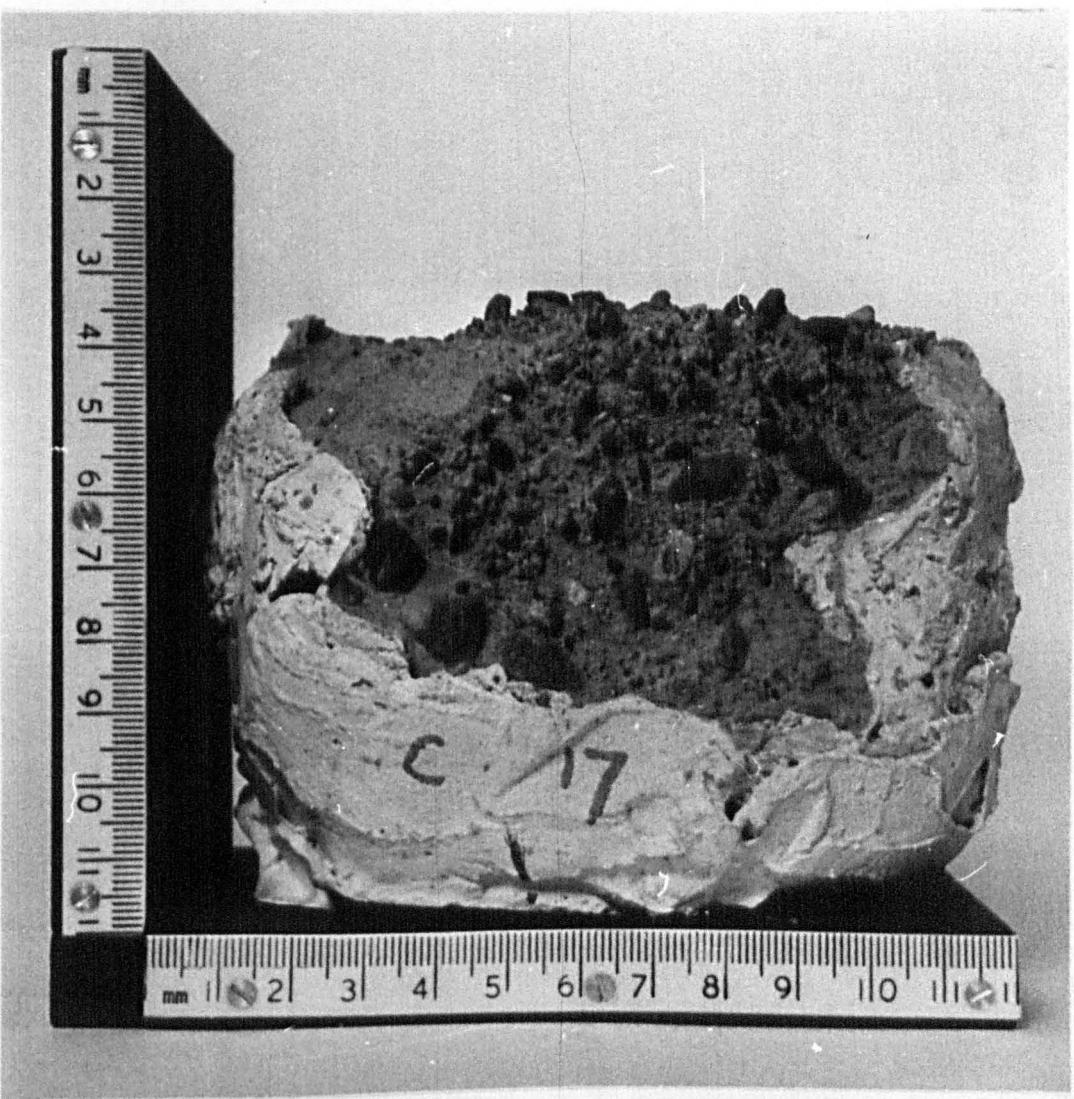


PLATE 6.3 BREIDAMERKURJOKULL SAMPLE BR/C17  
LEVELLED WITH PLASTER REMOVED FROM  
UPPER SURFACE AND ONE SIDE.

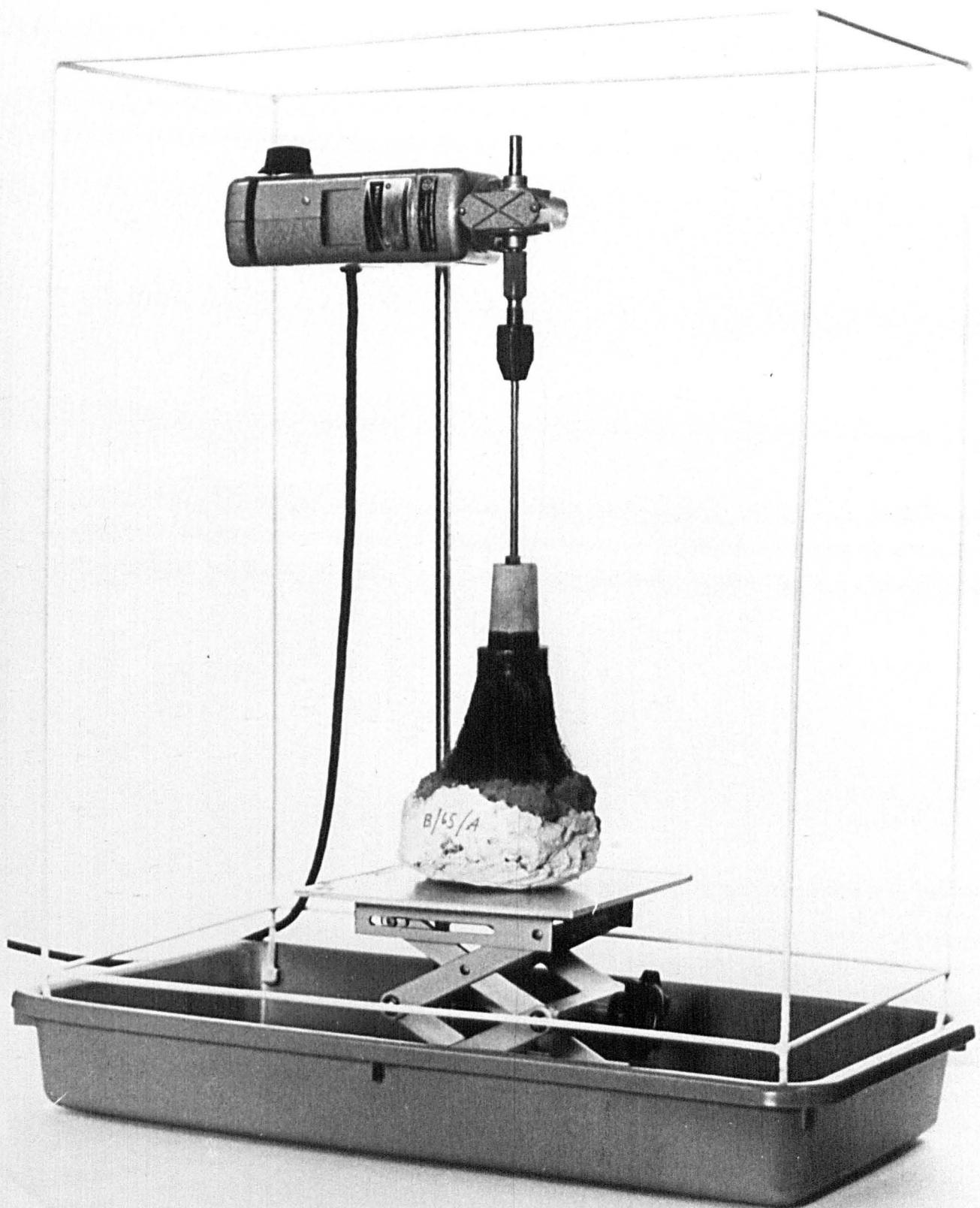


PLATE 6.4 VIEW OF BRUSHING APPARATUS.



PLATE 6.5 GLACIER SOLE GROOVED BY 1.5 m DIAMETER BOULDER.

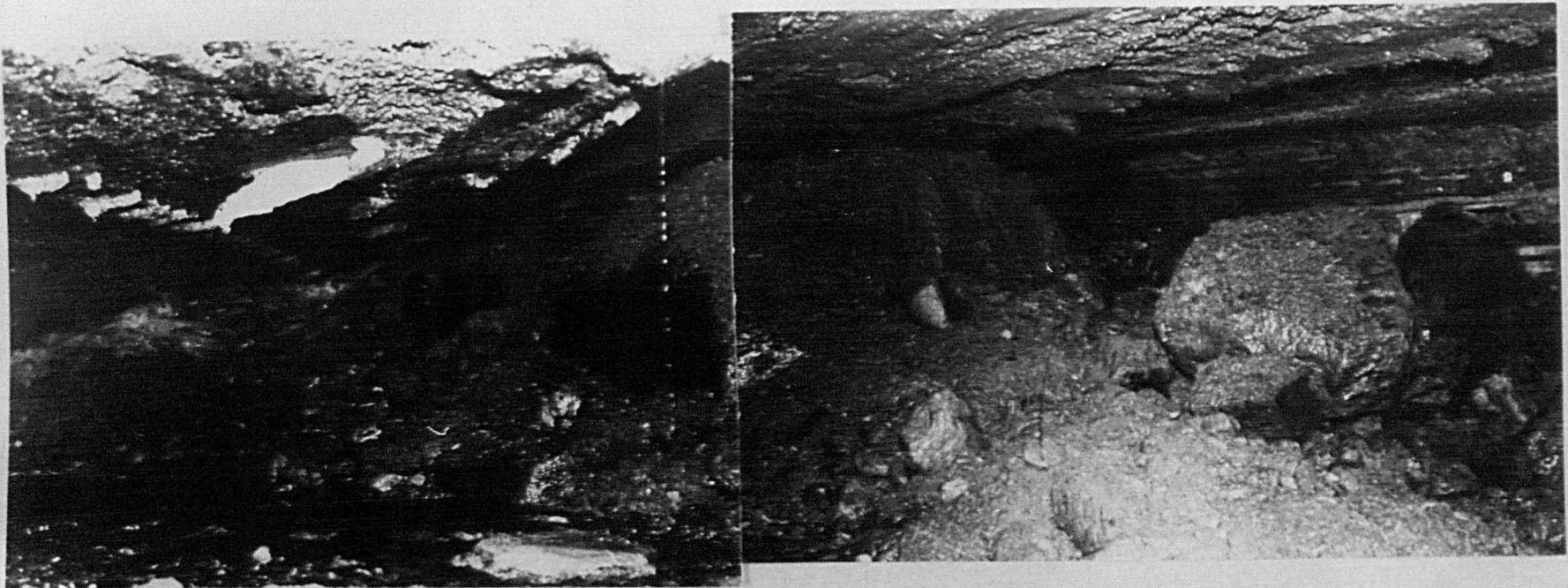


PLATE 6.6 GLACIAL SOLE GROOVED BY ROCHE MOUNTONNEE  
40 m INSIDE THE MARGIN OF BLAISEN, NORWAY.

(Note: Regelation ice clusters on left side, recording  
seventeen sliding events in the range 0.04 to 0.08 m)

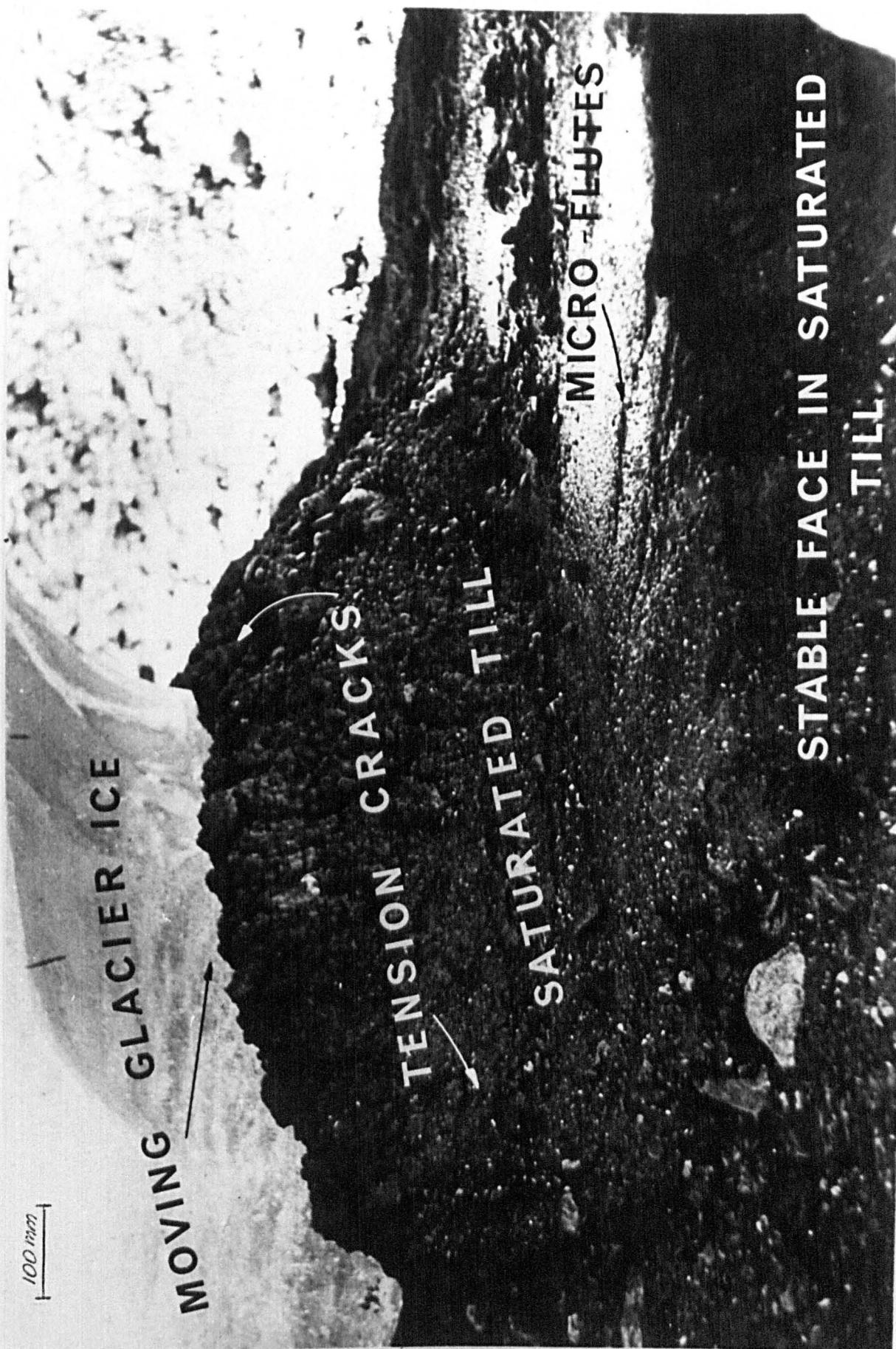


PLATE 6.7 A SMALL PUSH MORAINE IN PROCESS OF FORMATION AT THE MARGIN OF BLAISEN, SOUTHERN NORWAY.

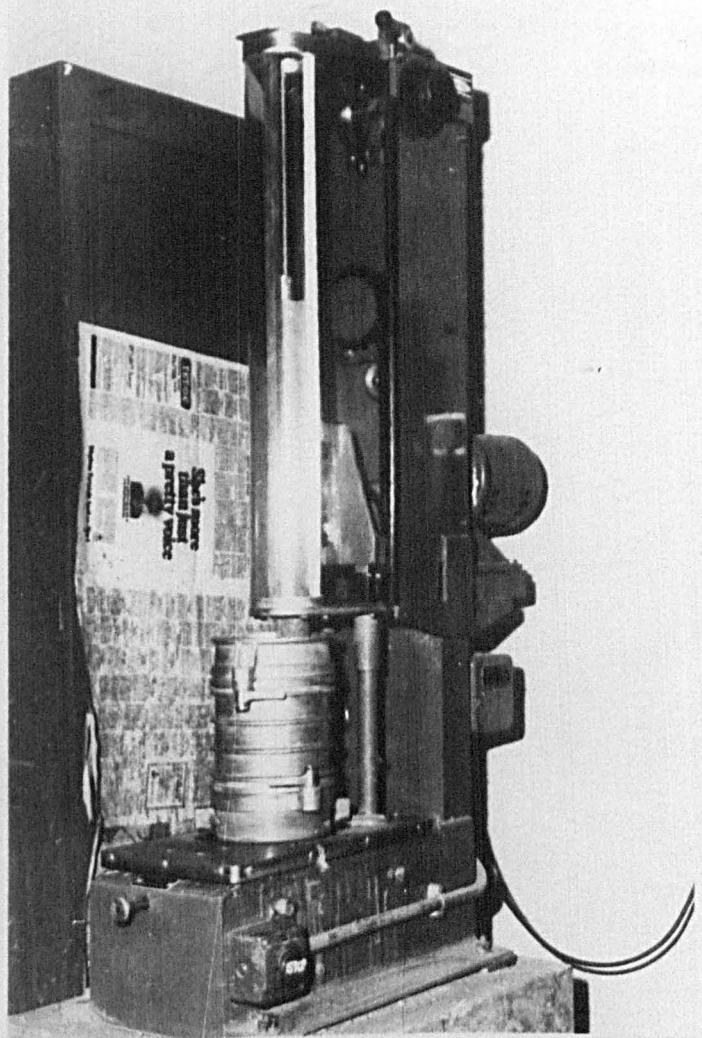


PLATE 7.1 AUTOMATIC COMPACTOR USED FOR  
TESTS WITH A C.B.R. MOULD  
FITTED TO BASE.

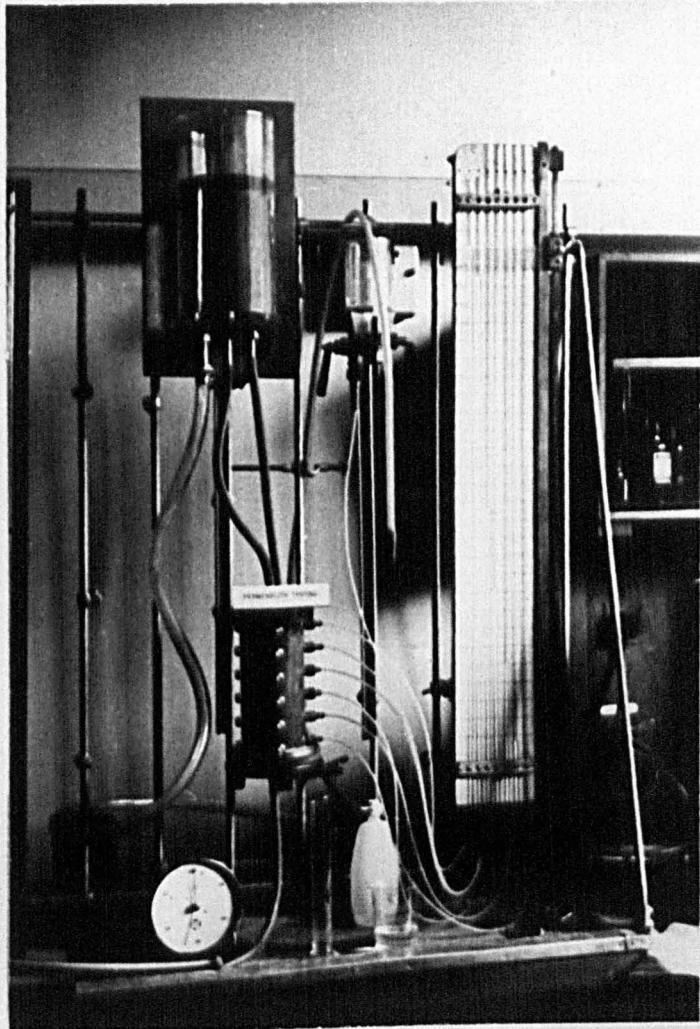


PLATE 7.2 THE PERMEABILITY APPARATUS

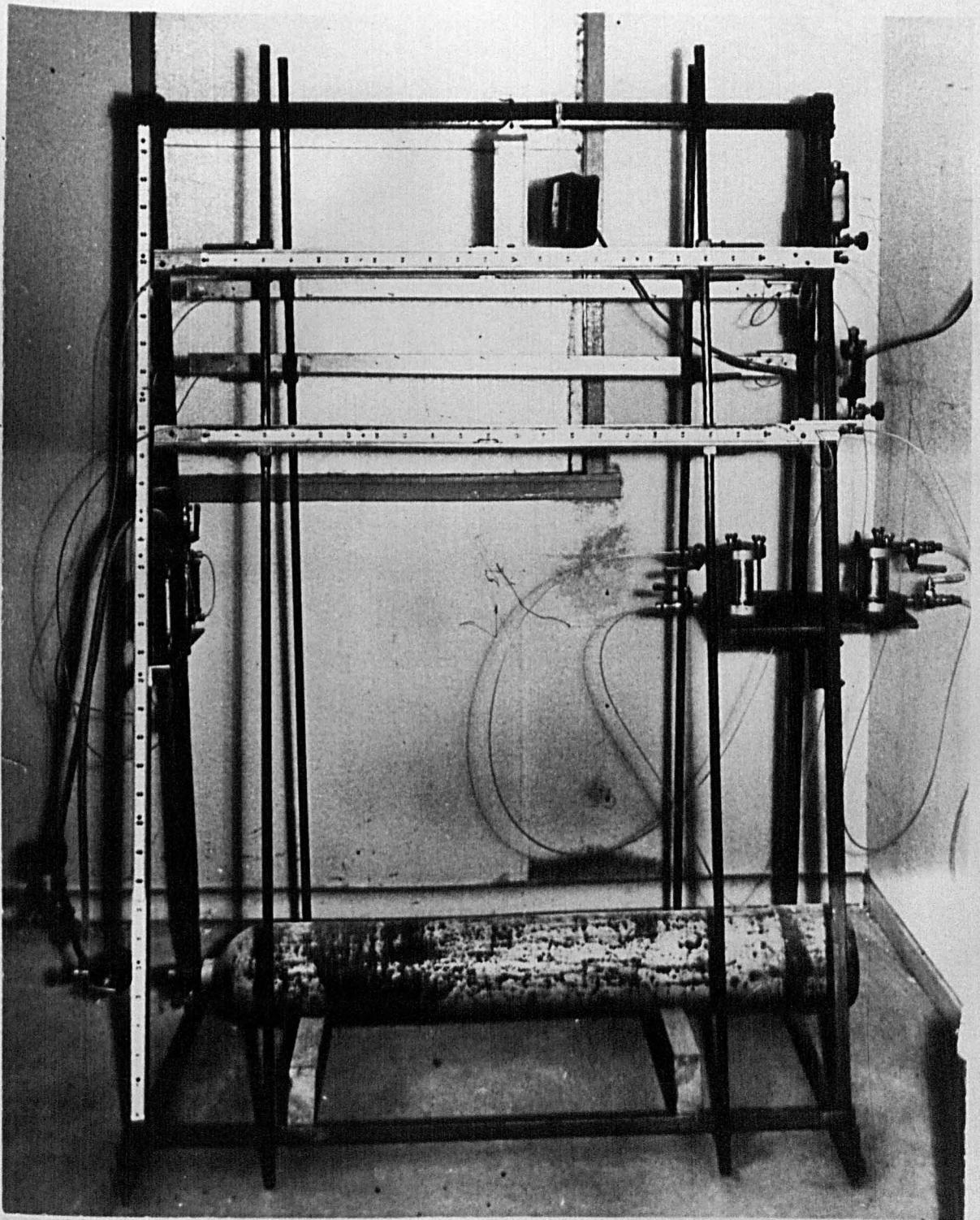
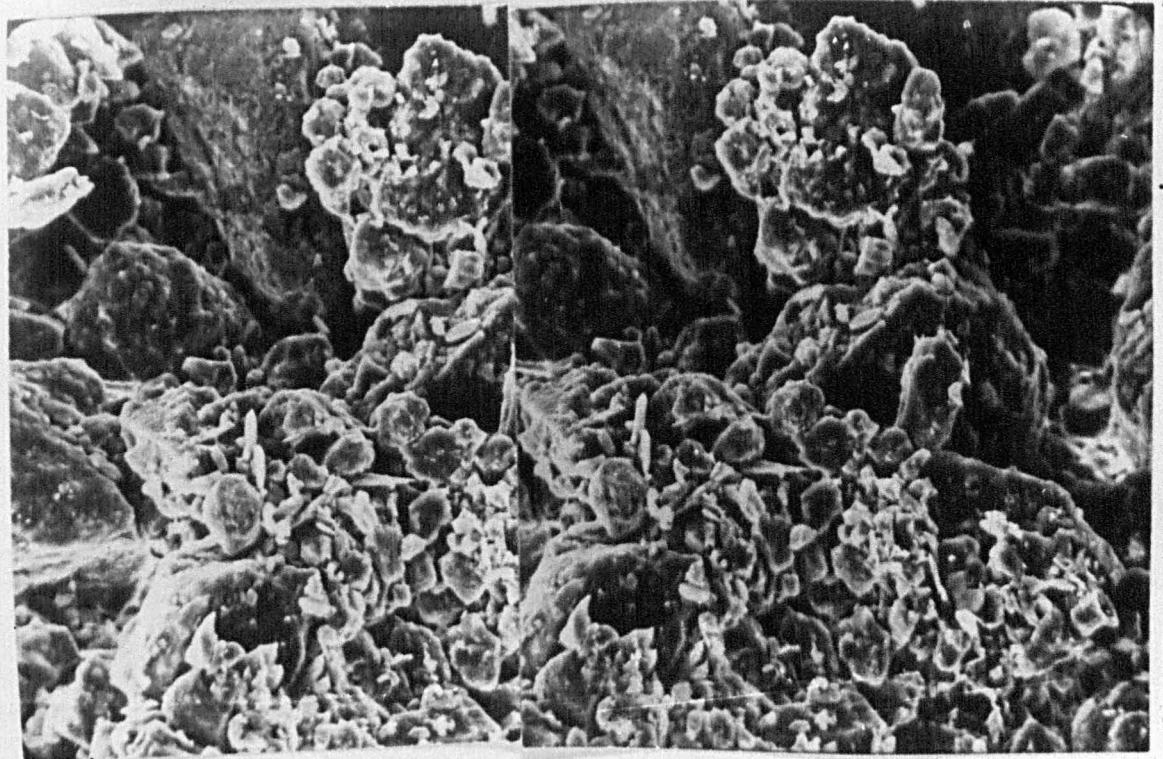


PLATE 7.3 CONSTANT HEAD PERMEABILITY APPARATUS (AFTER YOUNGER AND LIM, 1969)

MICROGRAPHS

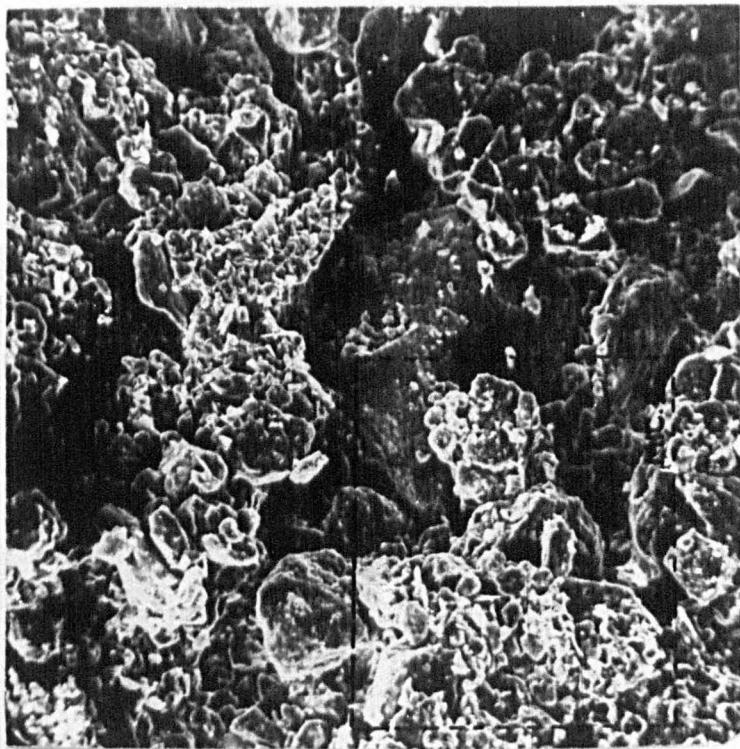


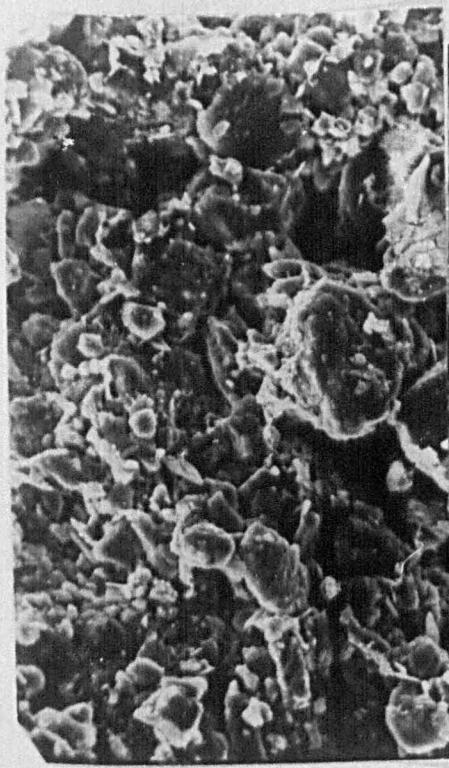
MIC.1. BLAISEN 1972 TILL

- DETAIL OF MIC.1.

MIC.1. BLAISEN 1972 TILL

- GRANULAR MATRICES AND AGGREGATIONS.

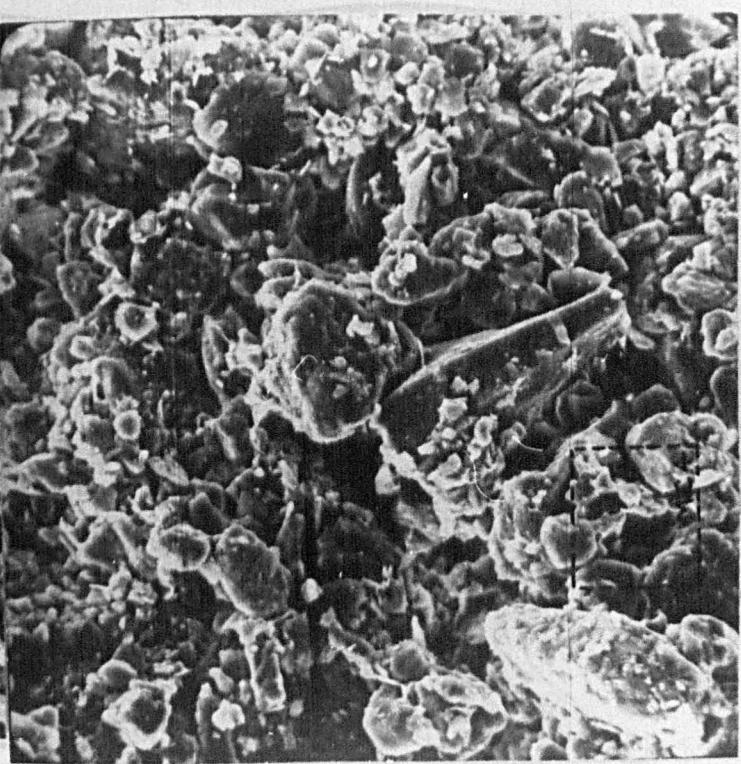




MIC. 3.

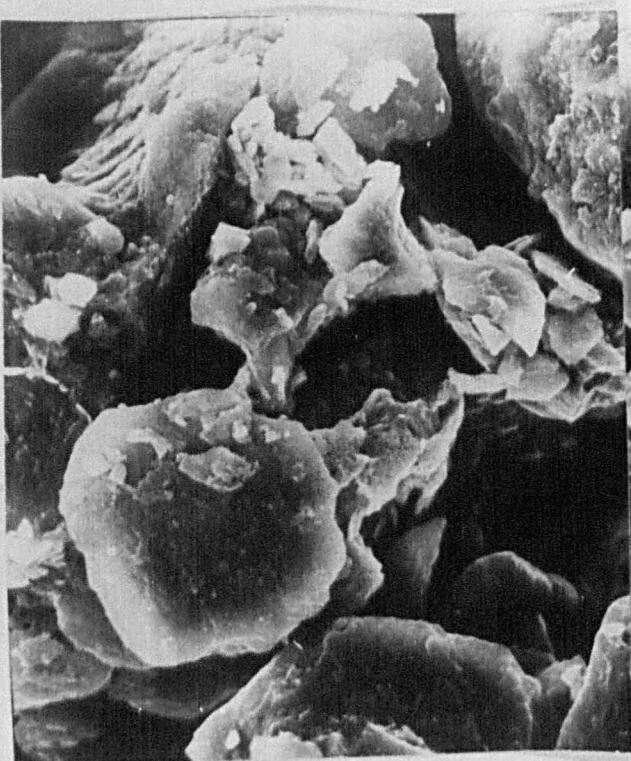
BLAISEN 1972 TILL

-OPEN GRANULAR AREA.



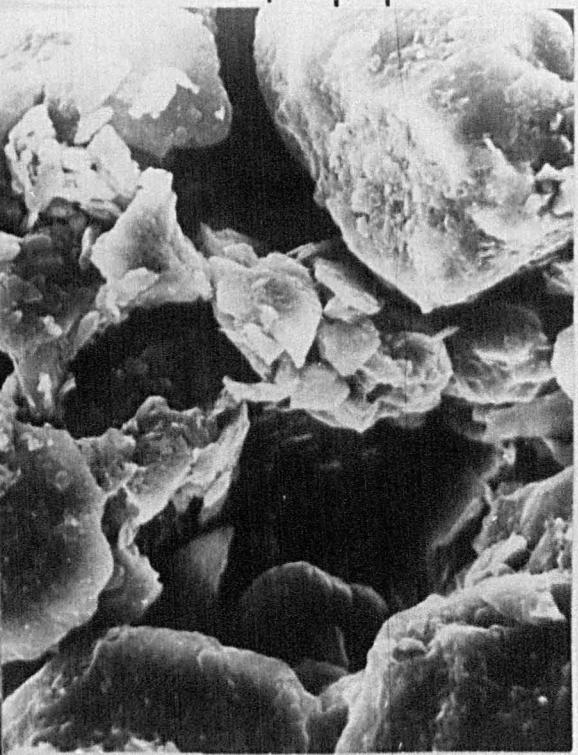
STEREO

100  $\mu$ m



STEREO.

25  $\mu$ m.



MIC. 4.

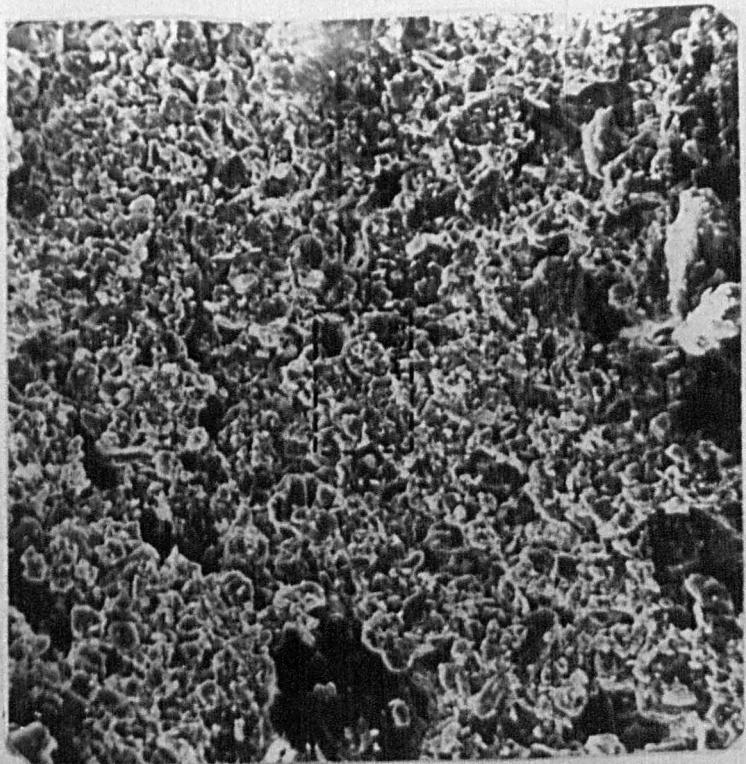
BLAISEN 1972 TILL

-DETAIL OF MIC. 3.

-OPEN CONNECTOR

MIC.5 BLAISEN 1972 TILL.

- COMPACT GRANULAR AREA.



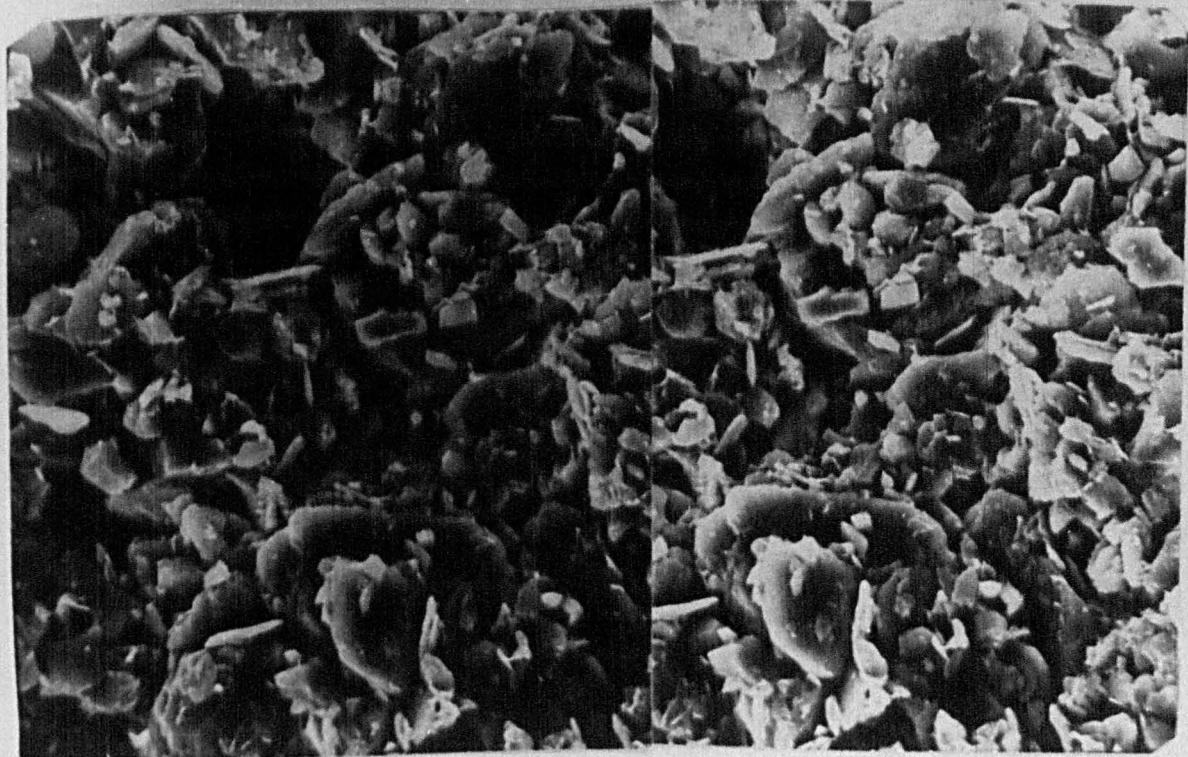
100 $\mu$ m

MIC.6.

BLAISEN 1972 TILL

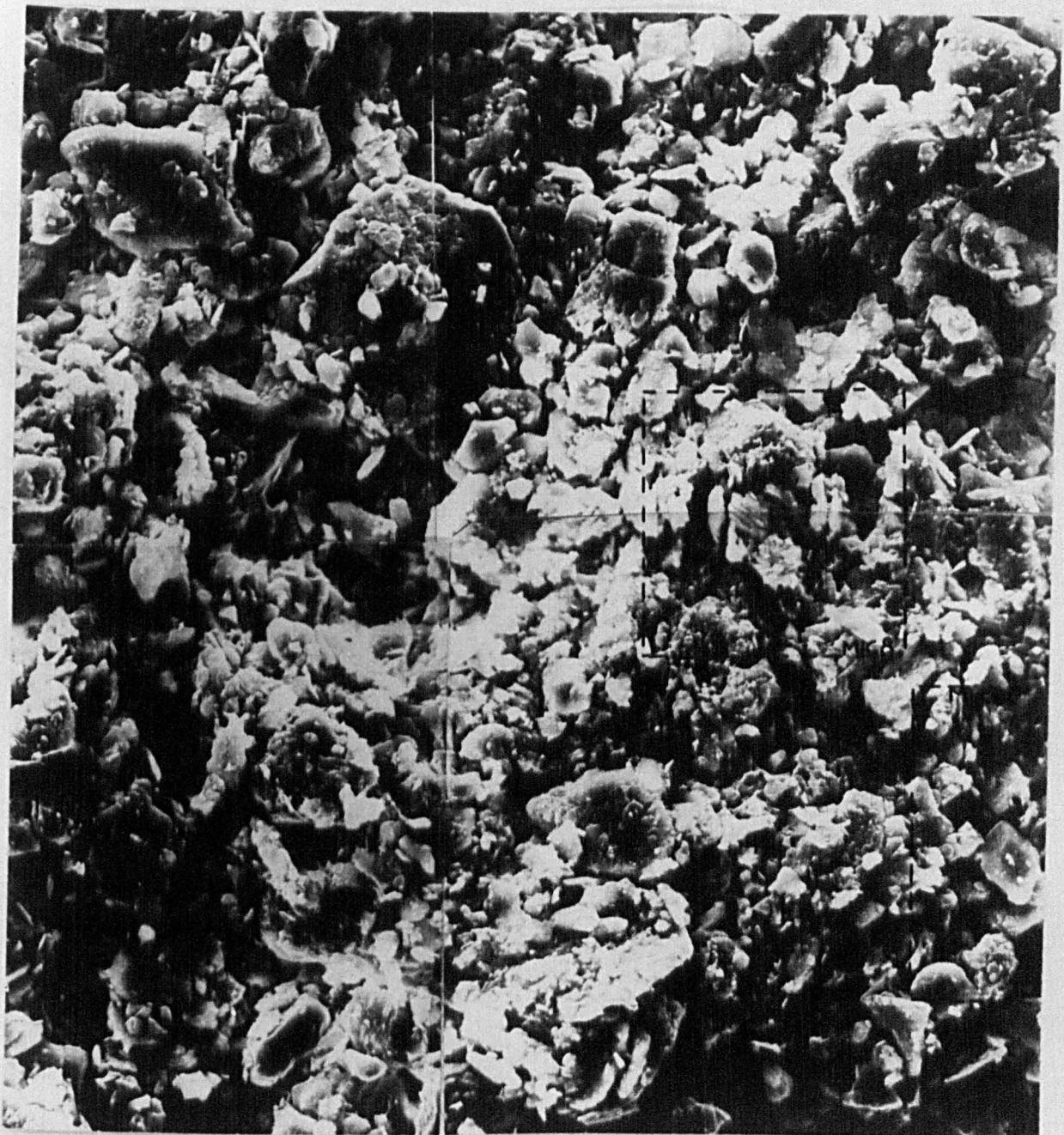
DETAIL OF MIC.5.

GRANULAR MATRIX.



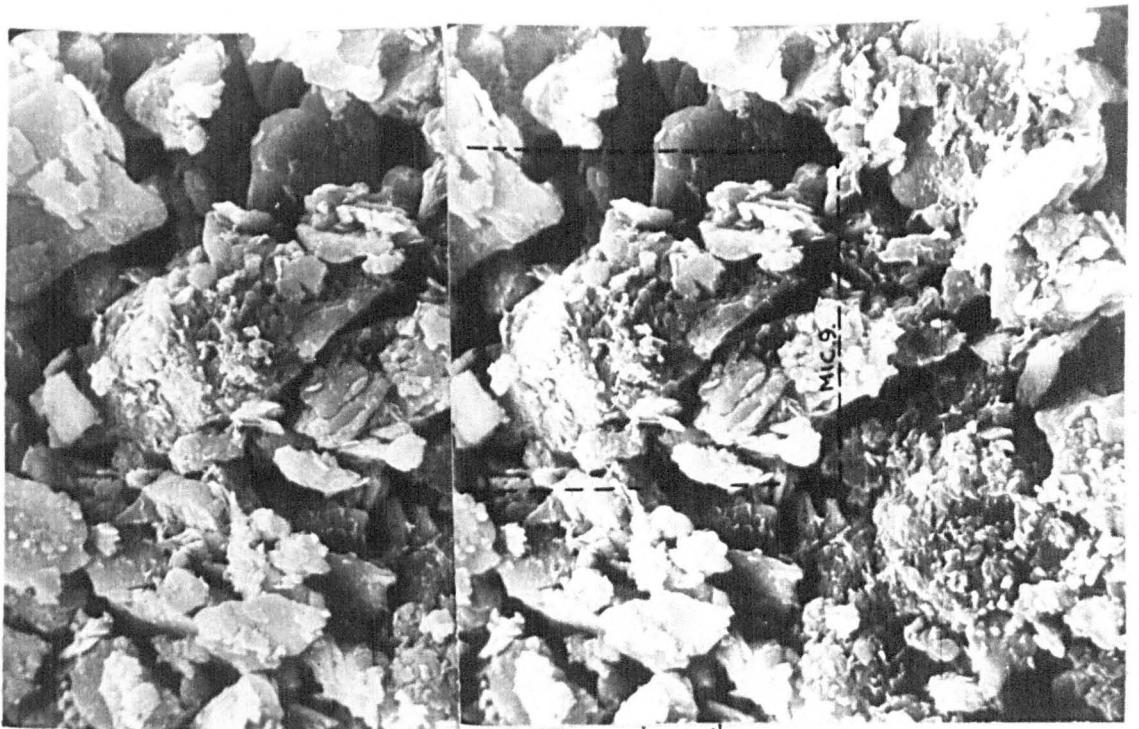
25 $\mu$ m

STEREO



MIC. 7. BLAISEN 1972 TILL - RELATIVELY FINES RICH AREA.

25  $\mu$ m



STEREO

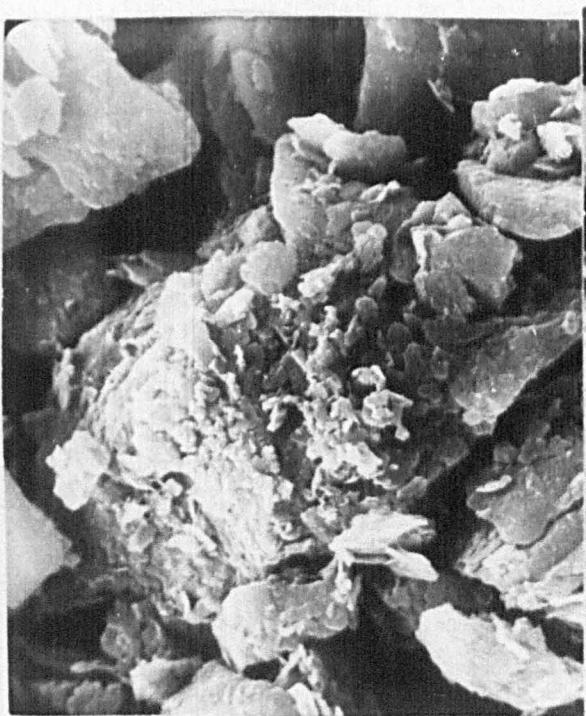
10  $\mu$ m

MIC. 8.

BLAISEN 1972 TILL.

- DETAIL OF MIC. 7.

- FINE AREA.



STEREO

2  $\mu$ m

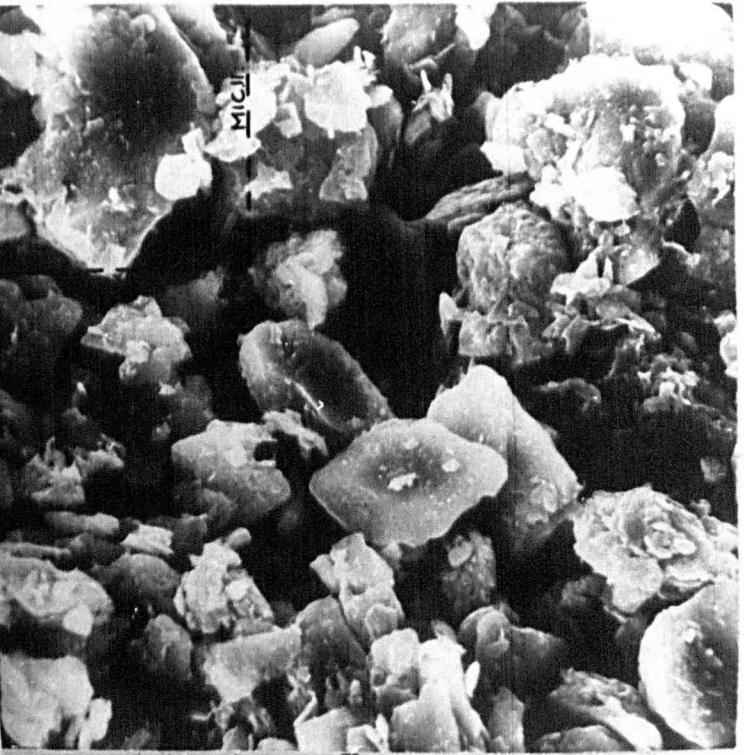
MIC. 9.

BLAISEN 1972 TILL.

- DETAIL OF MIC. 8.

- FINE AGGREGATION.



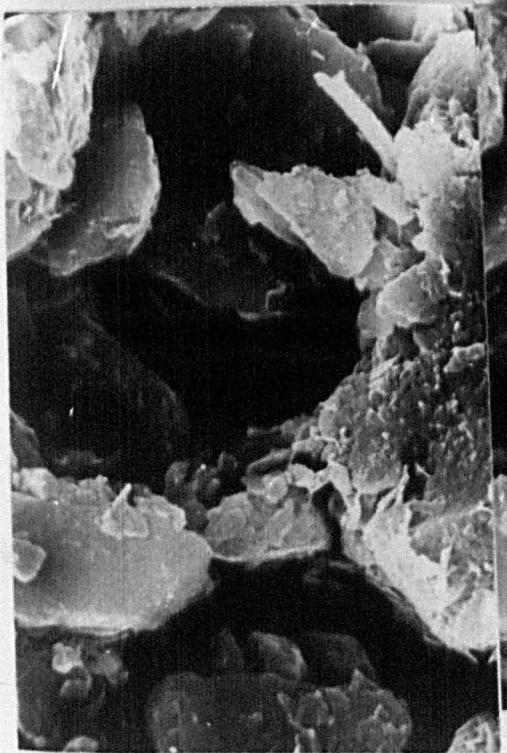


STEREO.

MIC.10.

BLAISEN 1972 TLL

-DETAIL OF AREA  
WITH AGGREGATION  
AND CONNECTORS



STEREO.

MIC.11.

BLAISEN 1972 TLL

-DETAIL OF MIC.10.  
- CONNECTOR.



25  $\mu$ m

MIC.12. BLAISEN 1965 TILL - GRANULAR MATRIX.



MIC. 14.

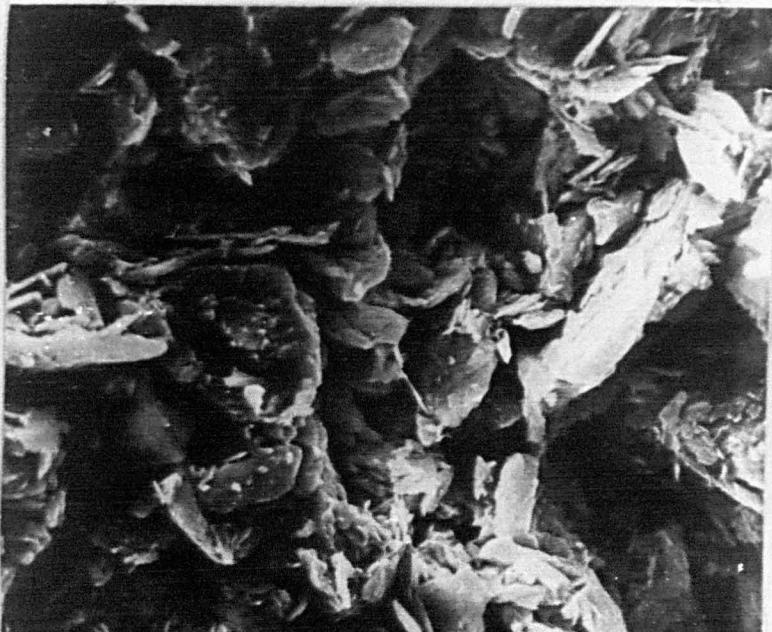
BLAISEN 1965 TILL

-DETAIL OF MIC.13.



STE.REO

10  $\mu$ m



MIC. 13.

BLAISEN 1965 TILL

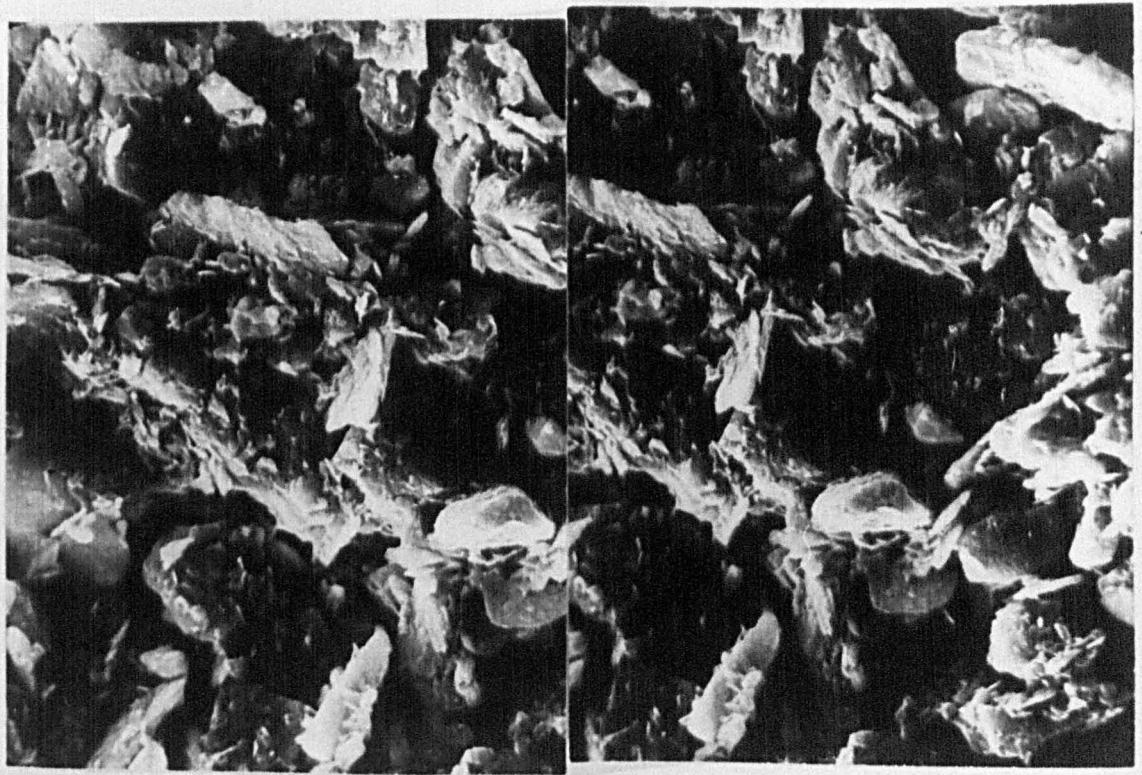
-DETAIL OF MIC.12.

- GRANULAR AREA.



STEREO.

25  $\mu$ m



MIC. 15.

BLAISEN 1965 TILL

- OPEN AREA WITH

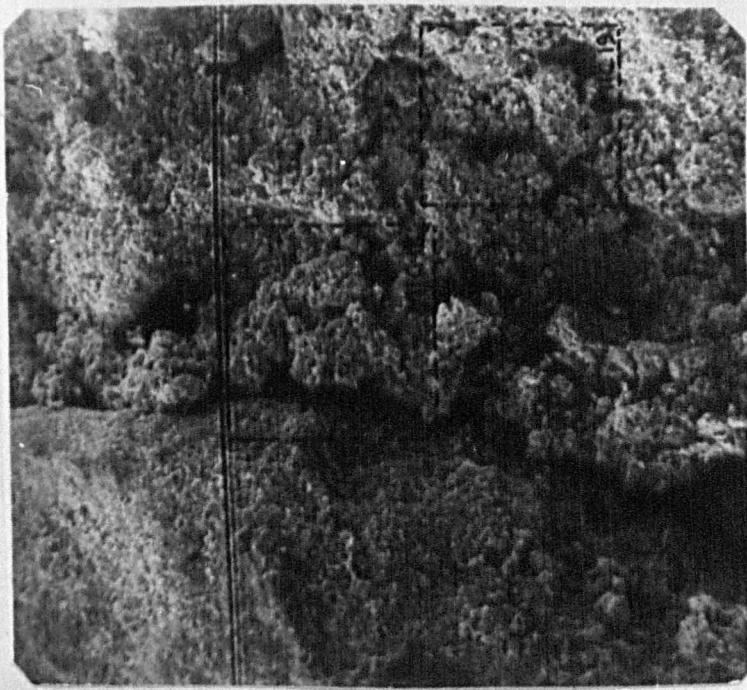
CLAY SIZES.

STEREO.



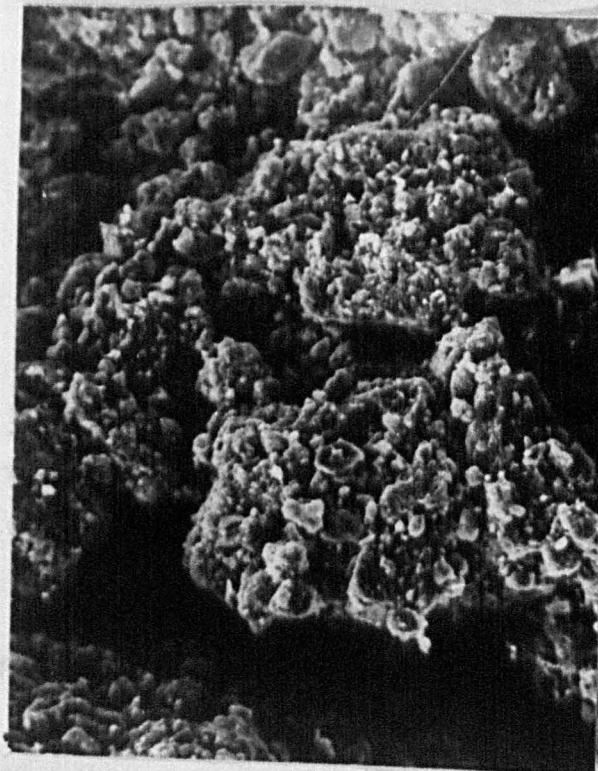
MIC.16. BLAISEN 1965 TILL - DETAIL OF CLAY SIZE ARRANGEMENTS.

10  $\mu$ m

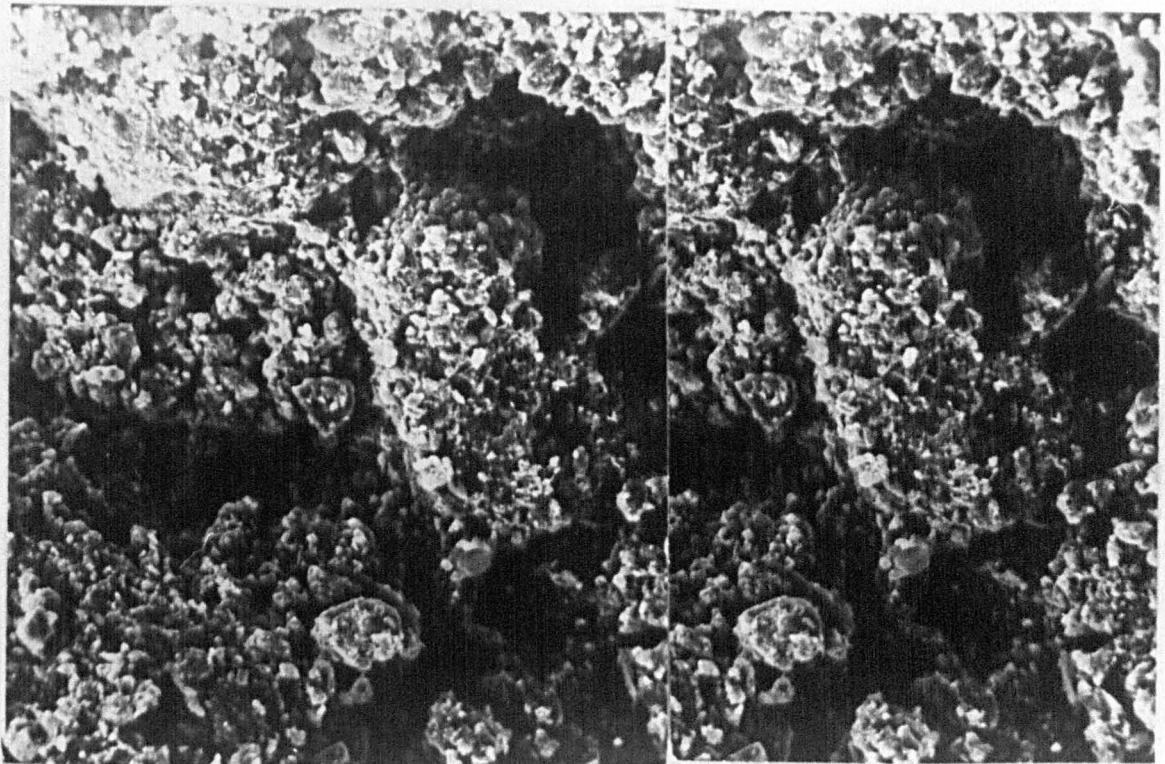


MIC.17. BREIDAMERKURJÖKKULL TILL  
— GENERAL FABRIC AT SIDE OF STONE.

STEREO.



MIC.18.  
BREIDAMERKURJÖKKULL  
TILL— DETAIL OF  
MIC.17-PORES



MIC.19.

BREIDAMERKUR-

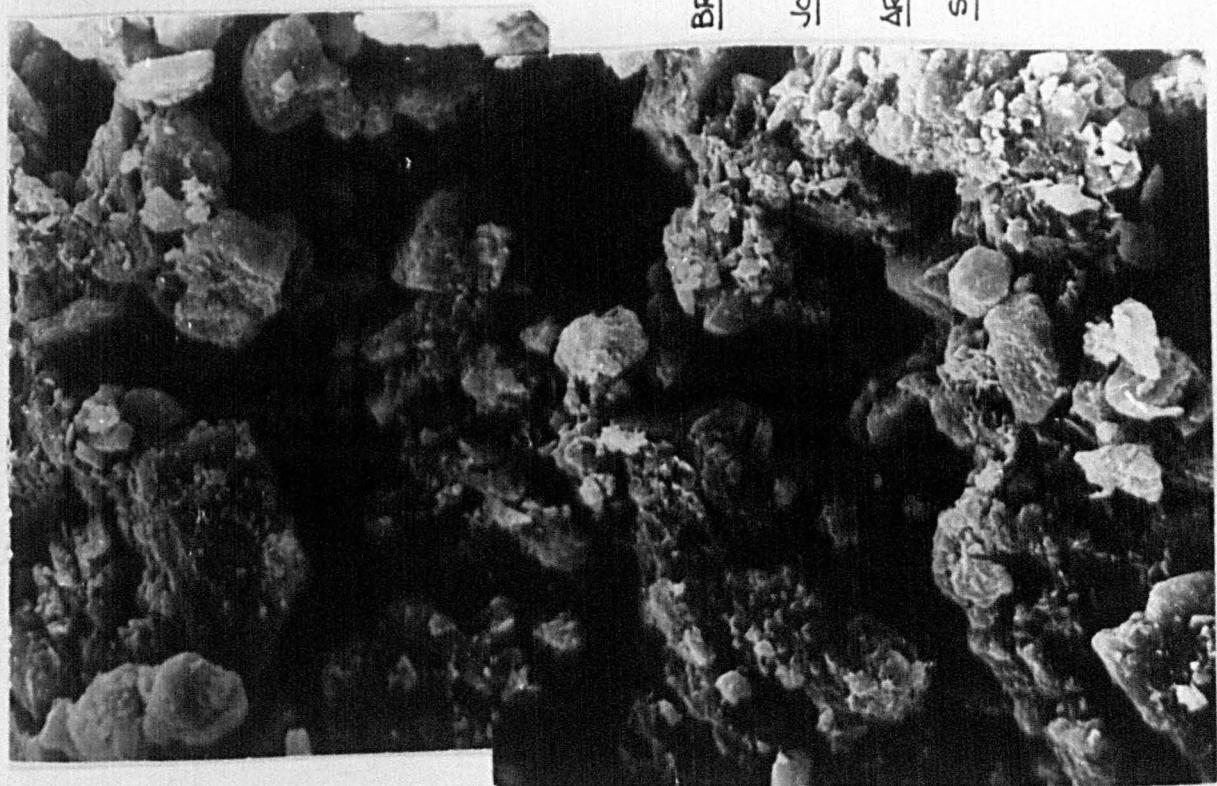
JOKULL TILL - AN

AREA AWAY FROM

STONE.

STEREO.

100 μm.



MIC.20.

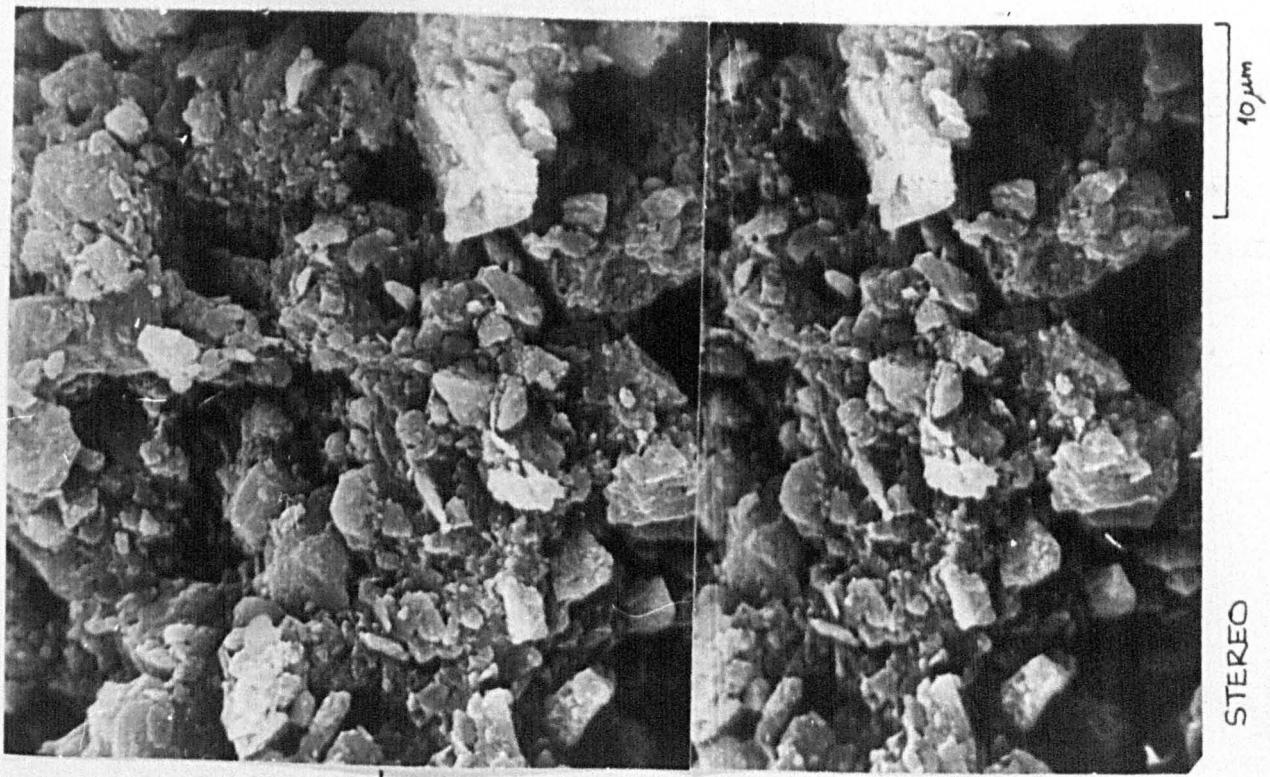
BREIDAMERKUR -

JOKULL TILL -

DETAIL OF MIC.19.

STEREO.

25 μm



MIC. 21.

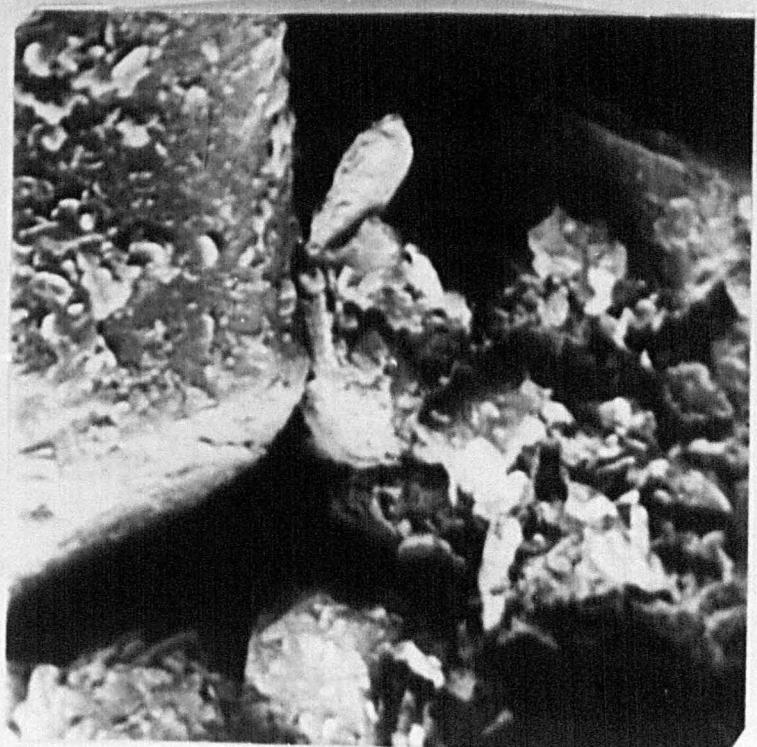
BREIDAMERKURJOKULL TILL

- AREA RICH IN FINES.

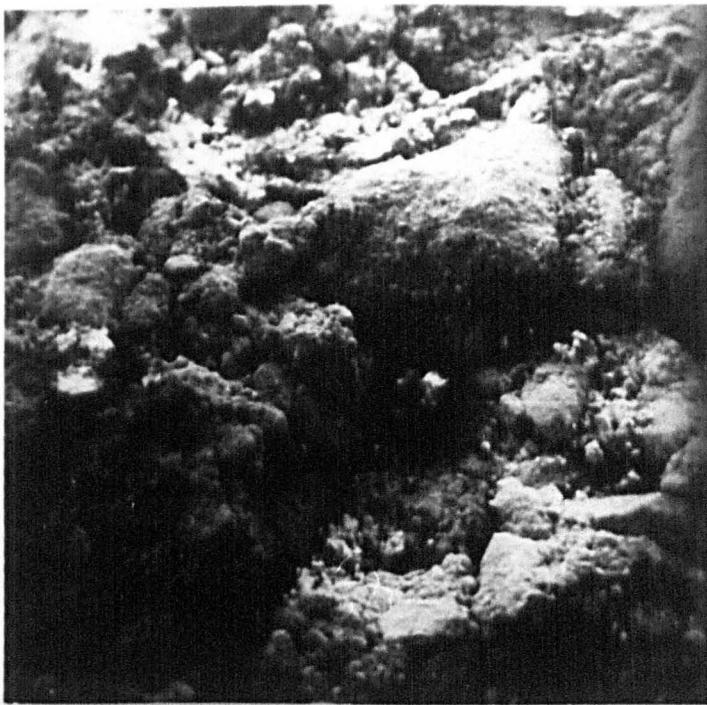
STEREO



MIC. 22 BREIDAMERKURJOKULL TILL  
- FINE AGGREGATIONS AND CONNECTORS



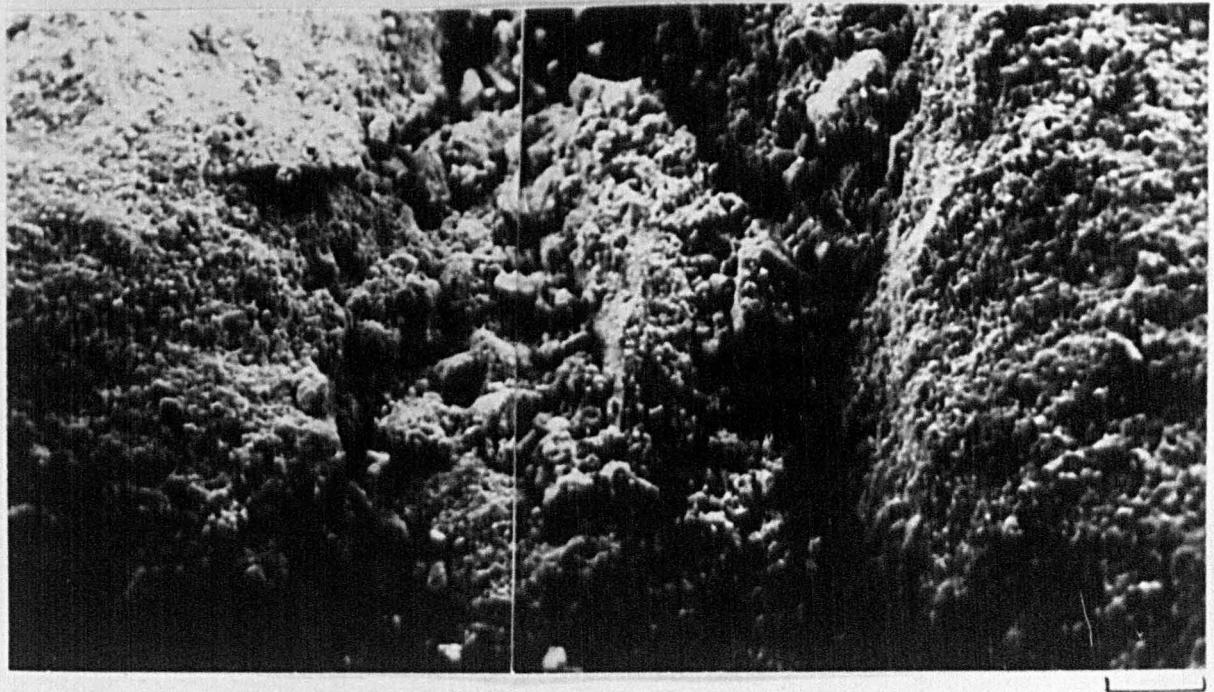
MIC. 23. BREIDAMERKURJOKULL TILL  
- DETAIL OF MIC. 22. - CONNECTOR.



MIC. 24. BREIDAMERKURJOKULL TILL

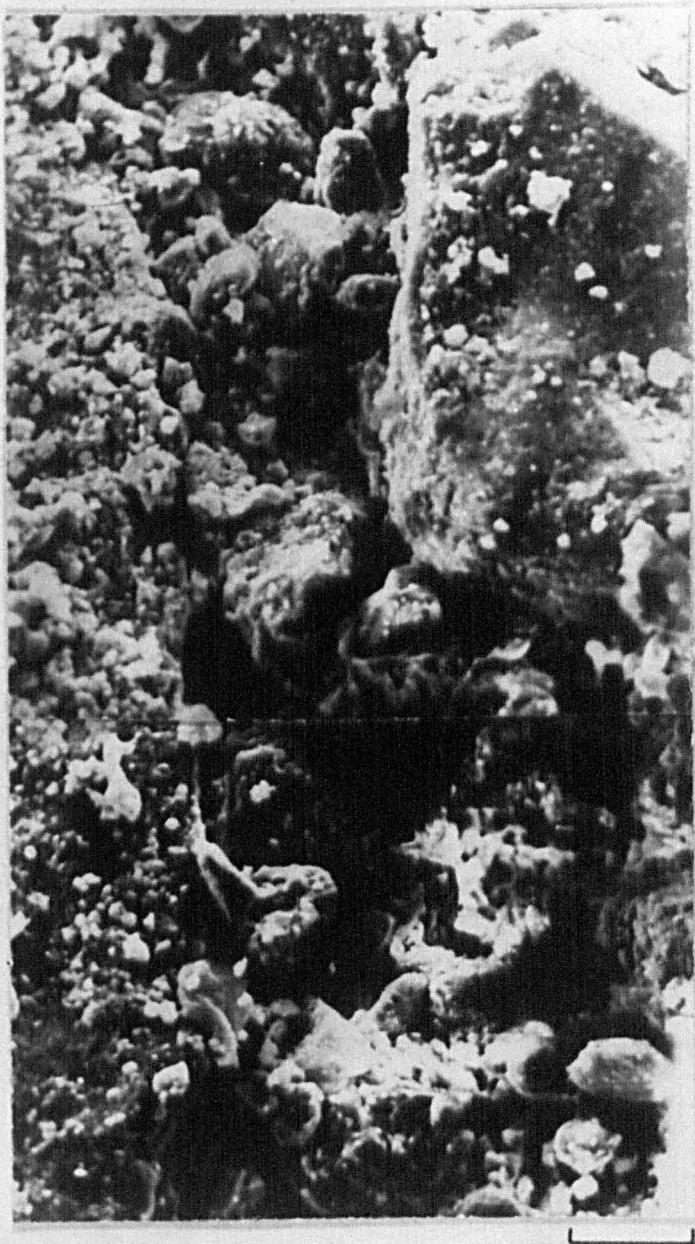
200  $\mu\text{m}$

- GENERAL VIEW OF GRANULAR AREA.



MIC. 25. BREIDAMERKURJOKULL TILL - DETAIL OF MIC. 24.

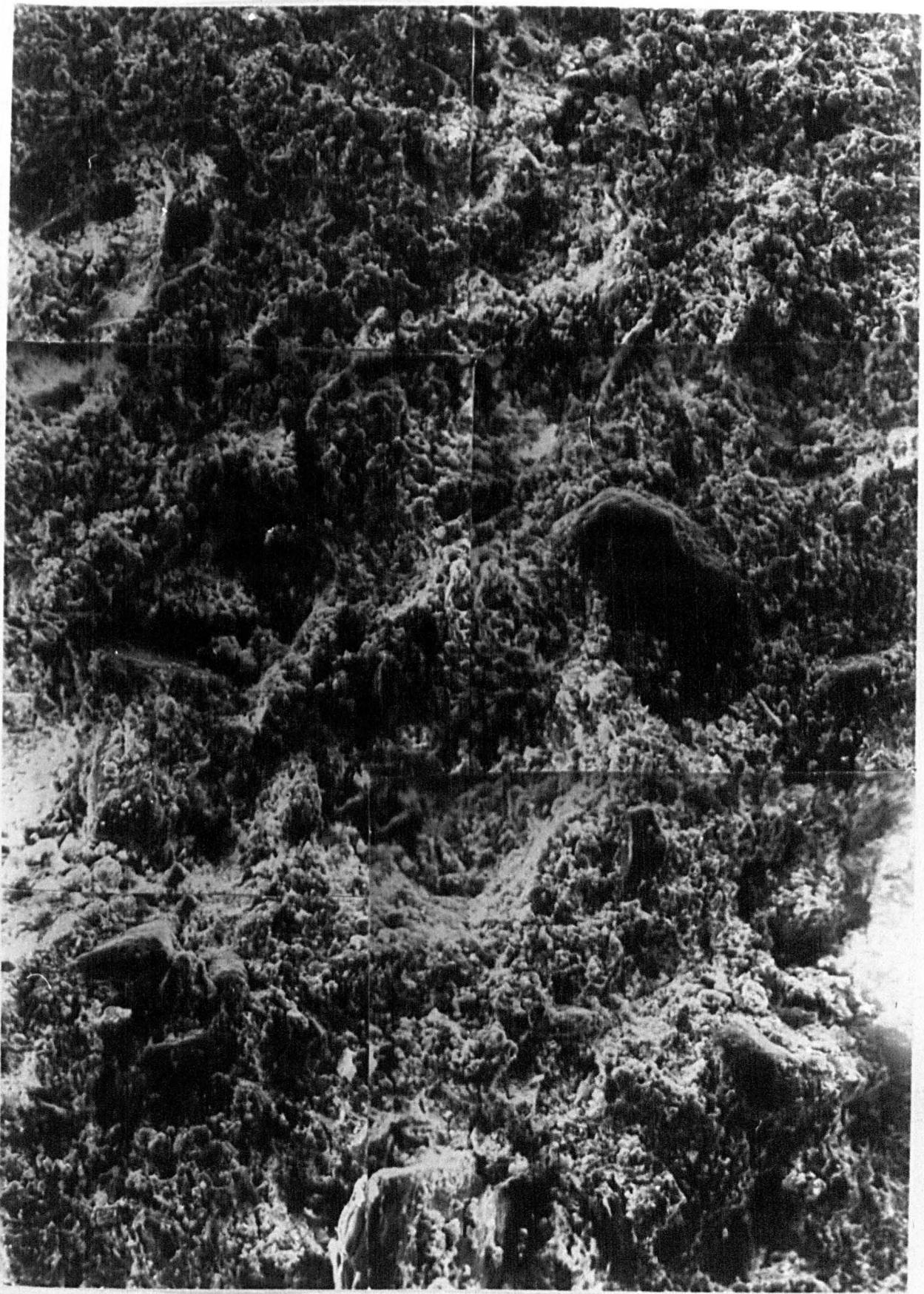
100  $\mu\text{m}$



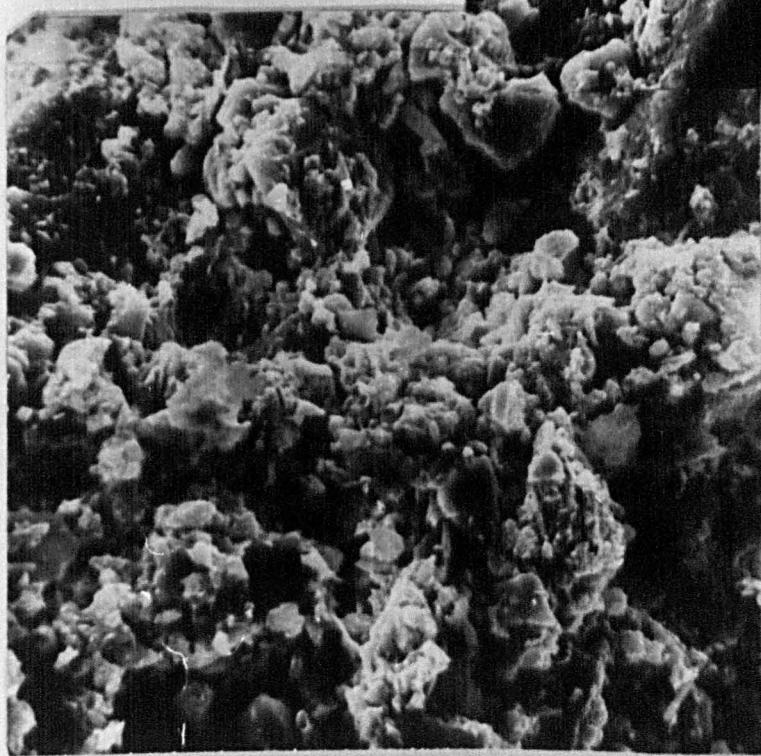
25  $\mu$ m

MIC. 26. BREIDAMERKURJOKULL TILL

- DETAIL OF MIC. 25.



MIC. 27. ANTARCTICA TILL - GENERAL NATURE OF FABRIC.



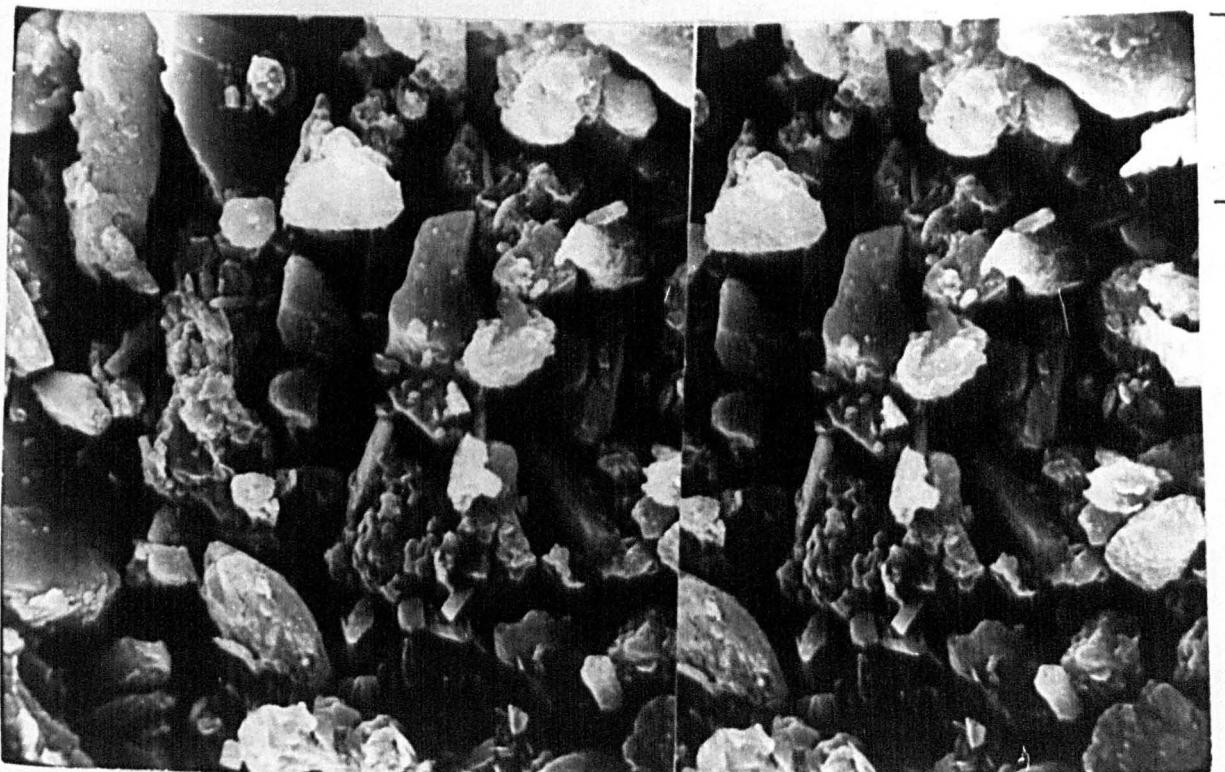
25  $\mu$ m

MIC. 28. ANTARCTICA TILL - SAND PARTICLE IN CLAY-  
GRANULAR MATRIX.



MIC. 29. ANTARCTICA TILL - DETAIL OF CLAY- GRANULAR MATRIX.

10  $\mu$ m



MIC. 30.

ANTARCTICA TILL

- OPEN GRANULAR AREA

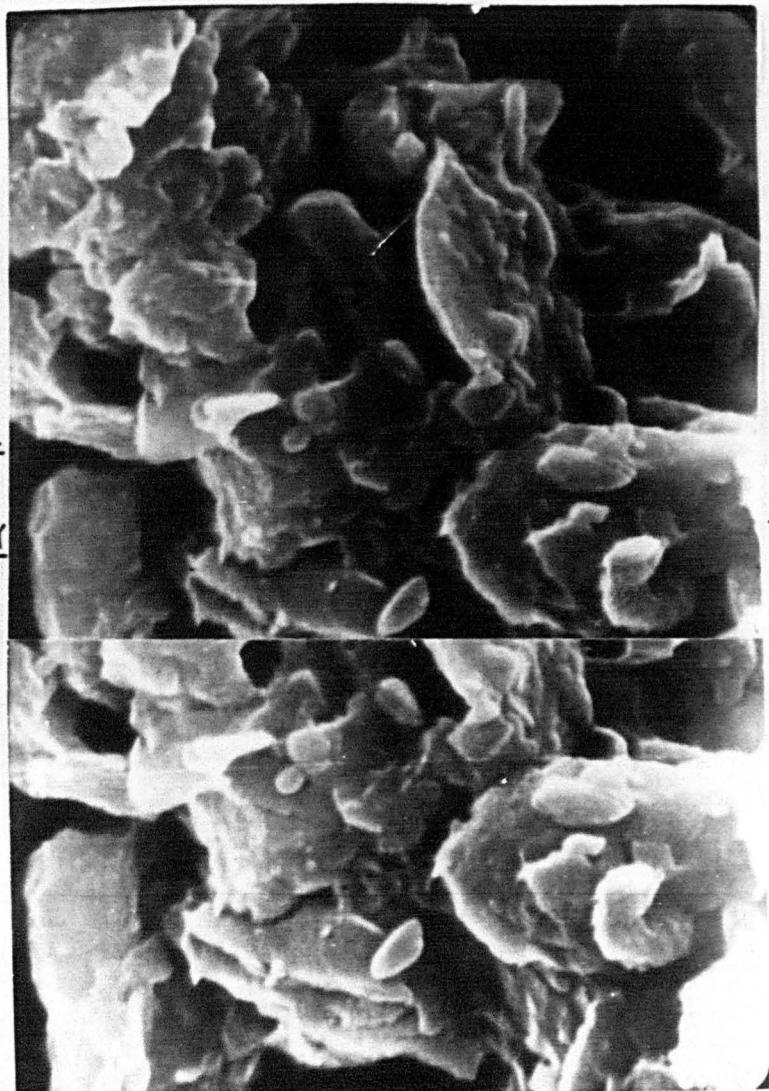
MIC.32.

ANTARCTICA TILL

-DETAIL OF PARTLY

DISCERNIBLE

FINES IN MIC.31.

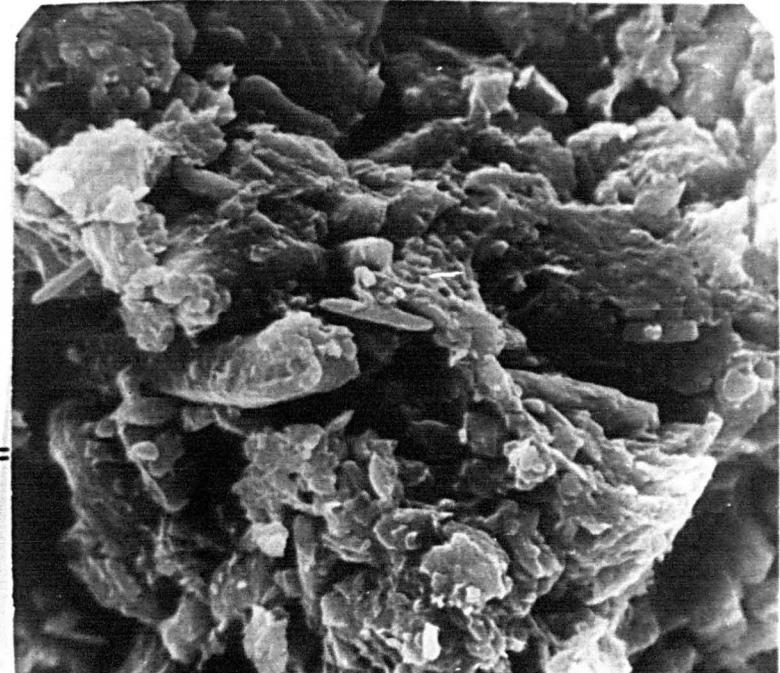


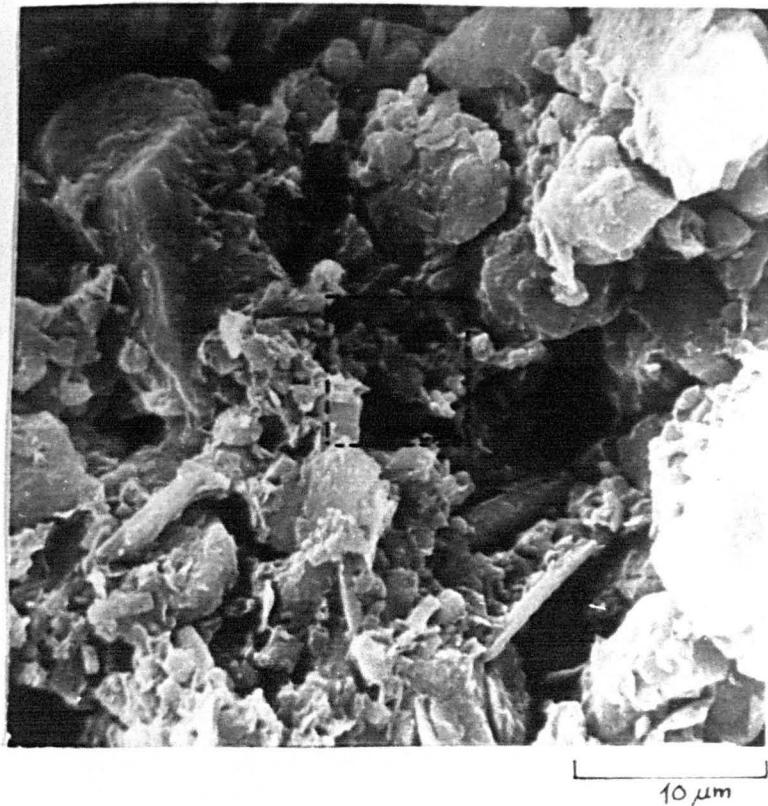
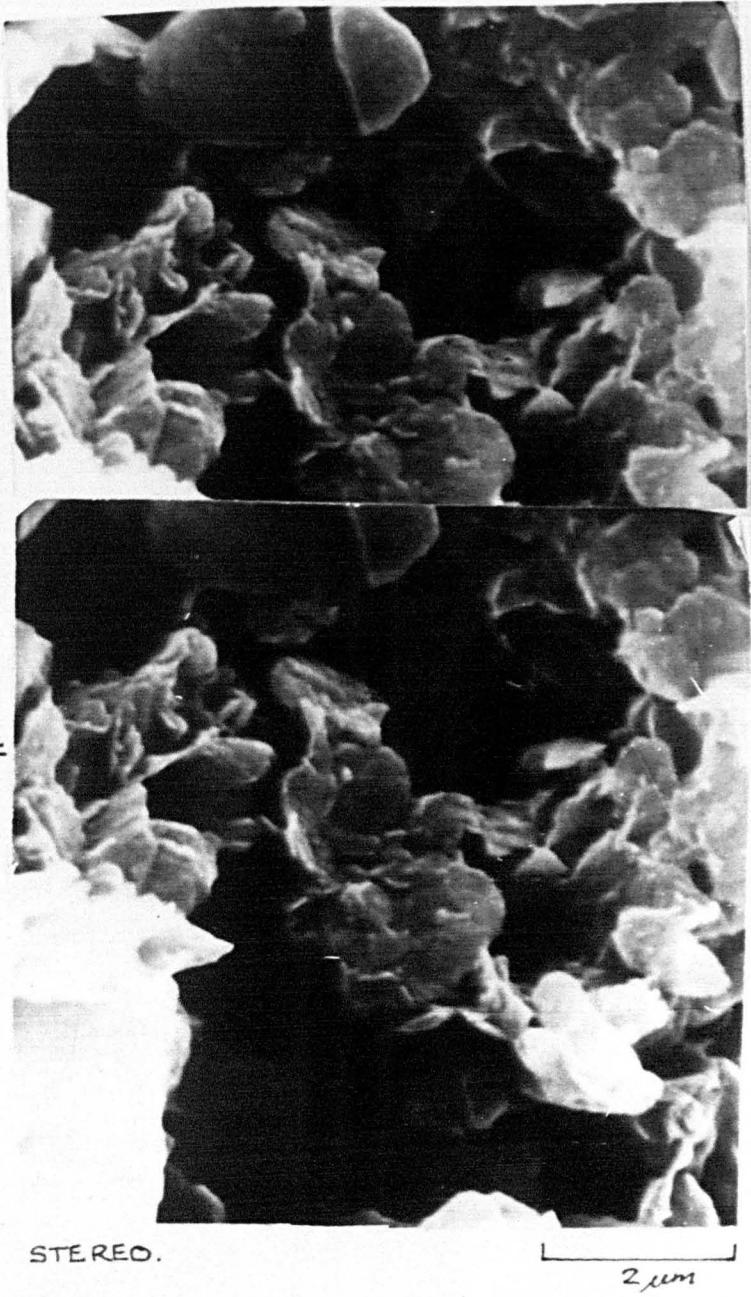
MIC.31.

ANTARCTICATILL

-FINES RICH

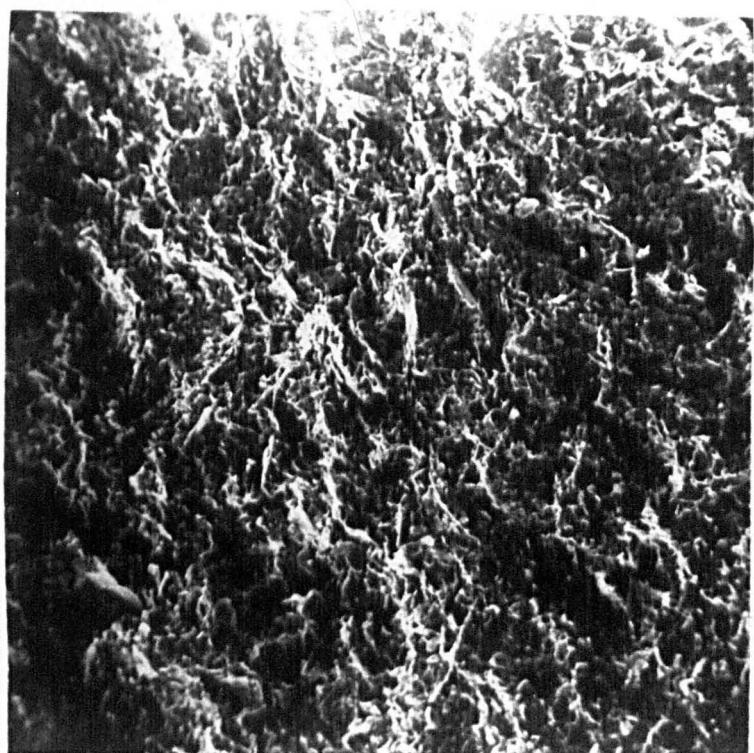
AREA.



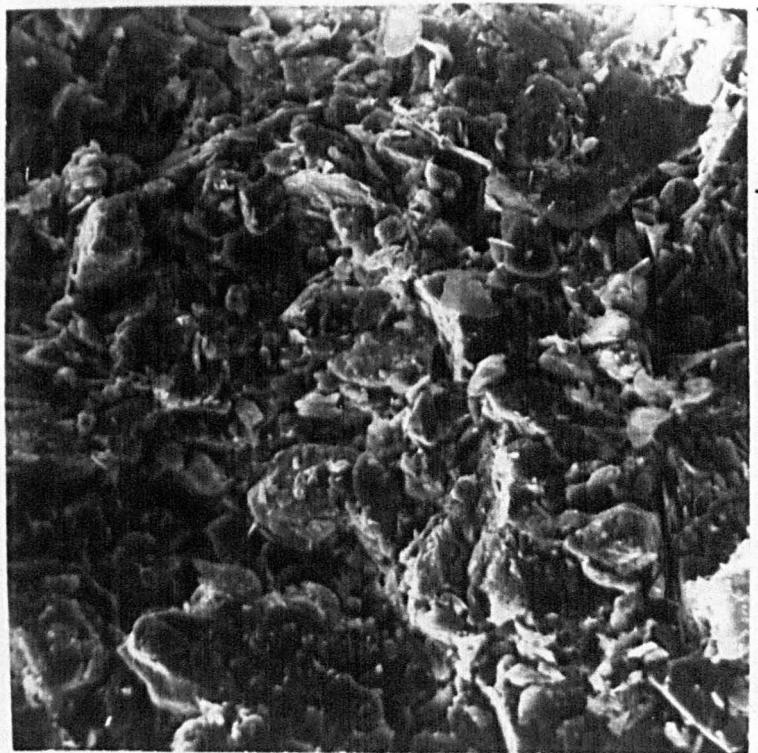


MIC.33.. ANTARCTICA TILL

- MORE OPEN FINE RICH AREA.



MIC. 35. COWAL TILL - GENERAL FABRIC.



MIC. 36. COWAL TILL - GENERAL MATRIX.



MIC. 37. COWAL TILL - MATRIX WITH CLOTHED GRAINS.

25  $\mu$ m

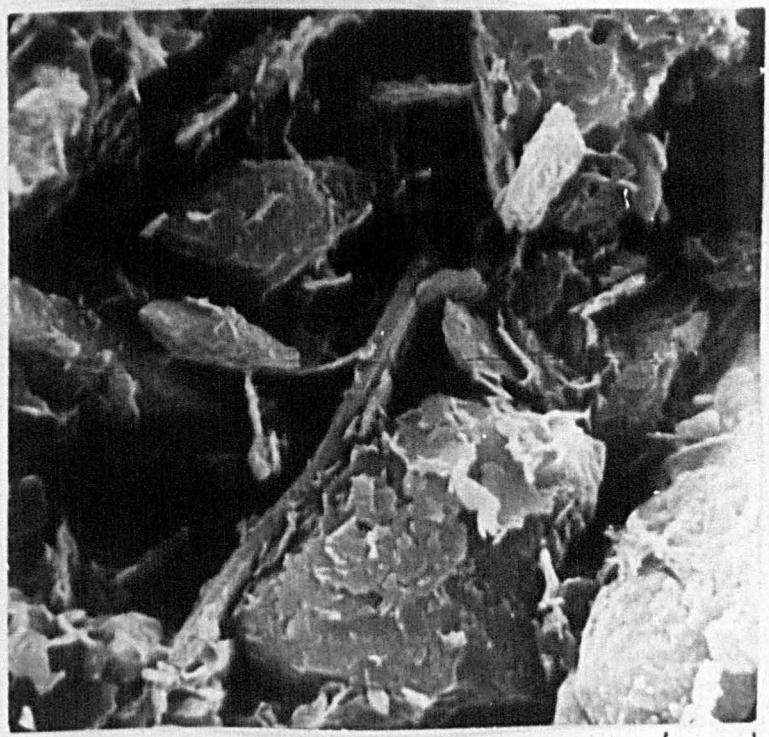


MIC 38. COAL TILL - THIN FLAKY FINE PARTICLES.

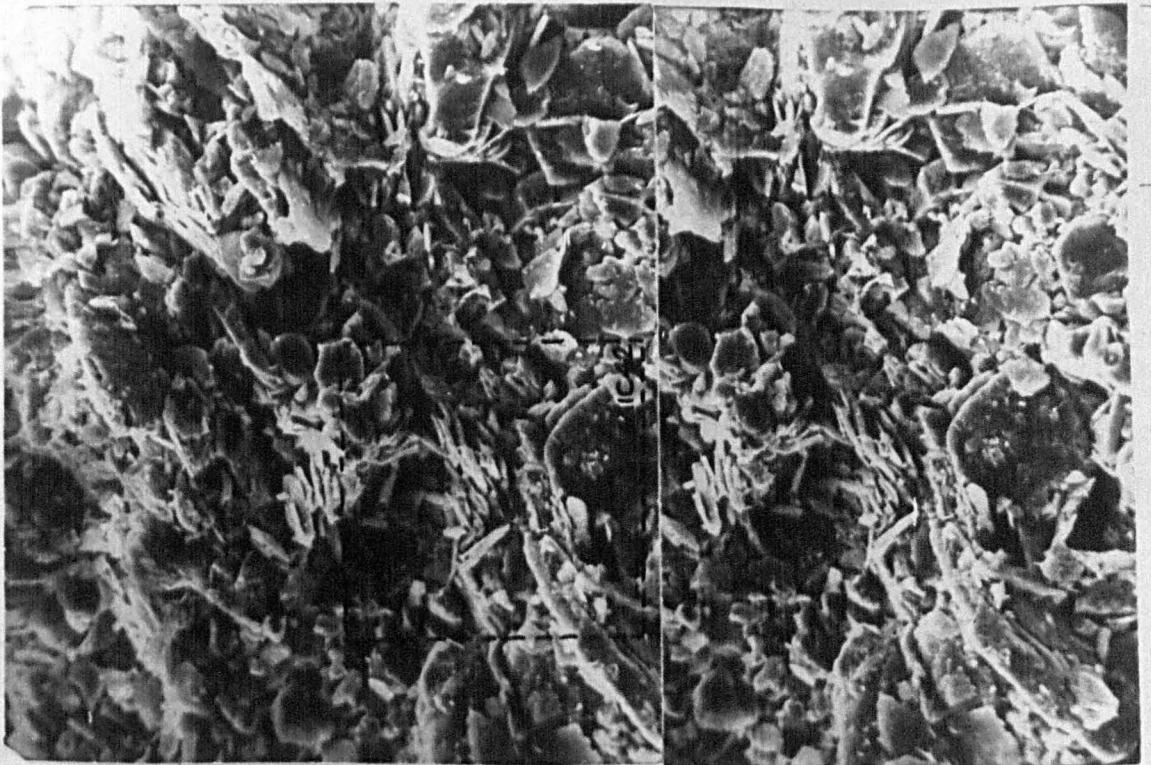


MIC. 39 COWAL TILL - AREA WITH CLAY SIZES.  $25\text{ }\mu\text{m}$

MIC. 40. COWAL TILL - DETAIL OF CLAY SIZES.



$2\text{ }\mu\text{m}$



100  $\mu$ m

STEREO

MIC. 41.

COWAL TILL  
-PARTICLES IN

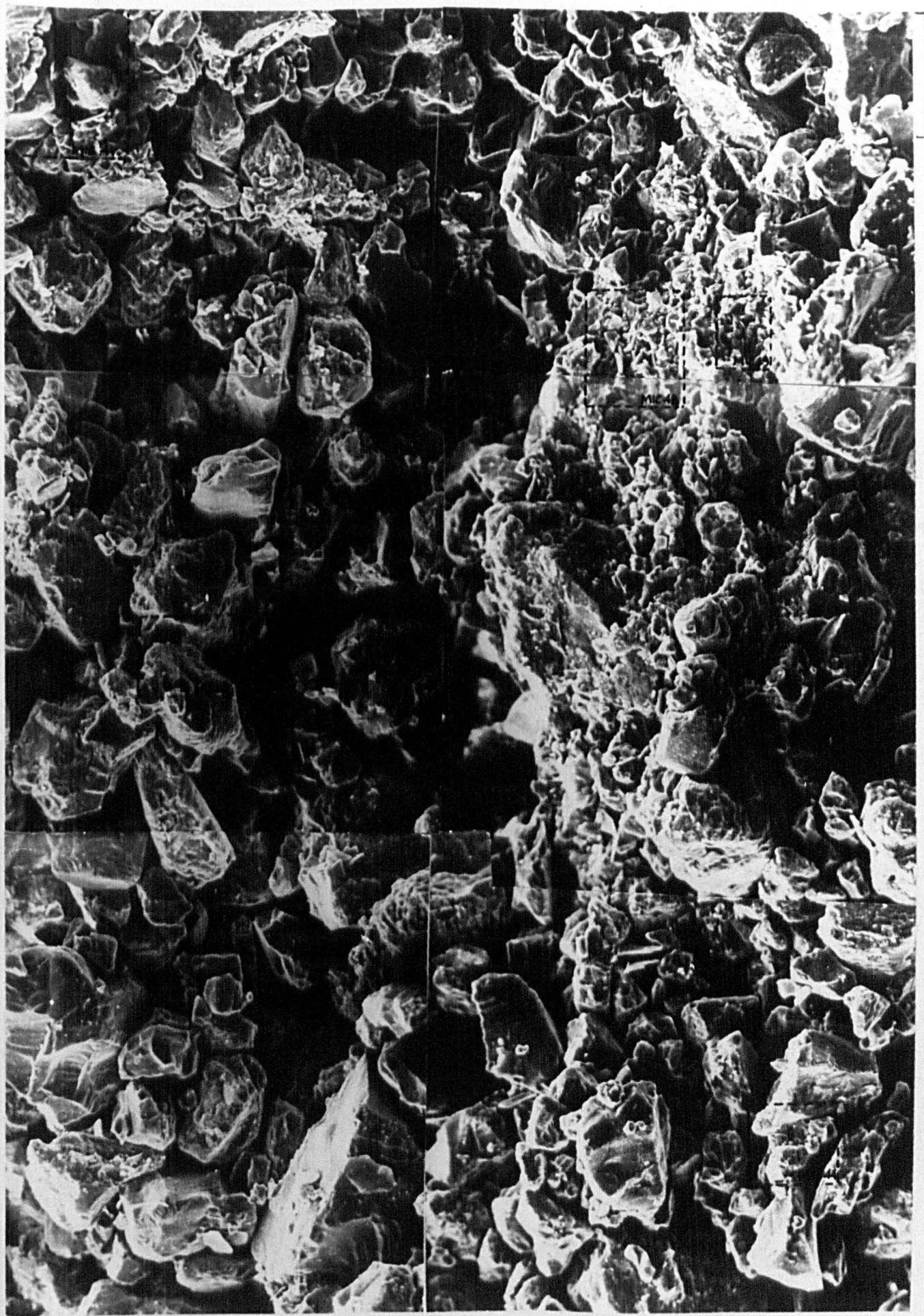
SHEAR ZONE.



25  $\mu$ m

MIC. 42.

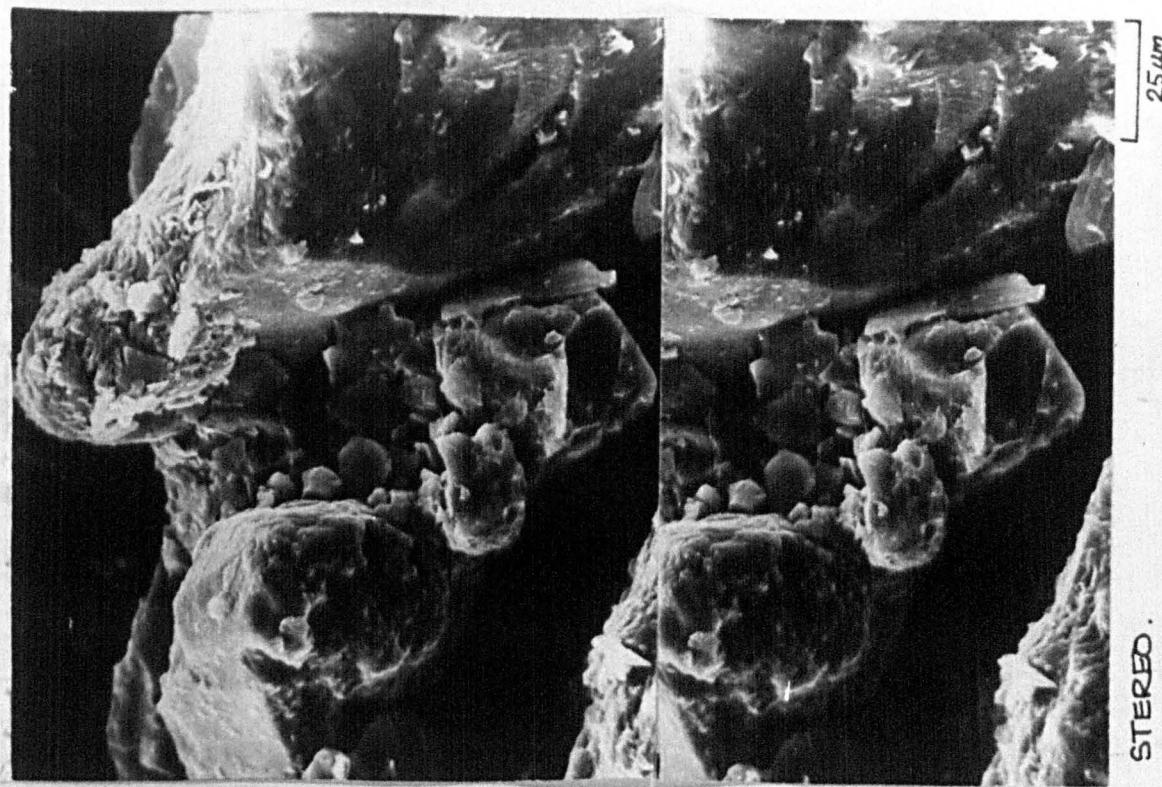
COWAL TILL  
- DETAIL OF MIC41



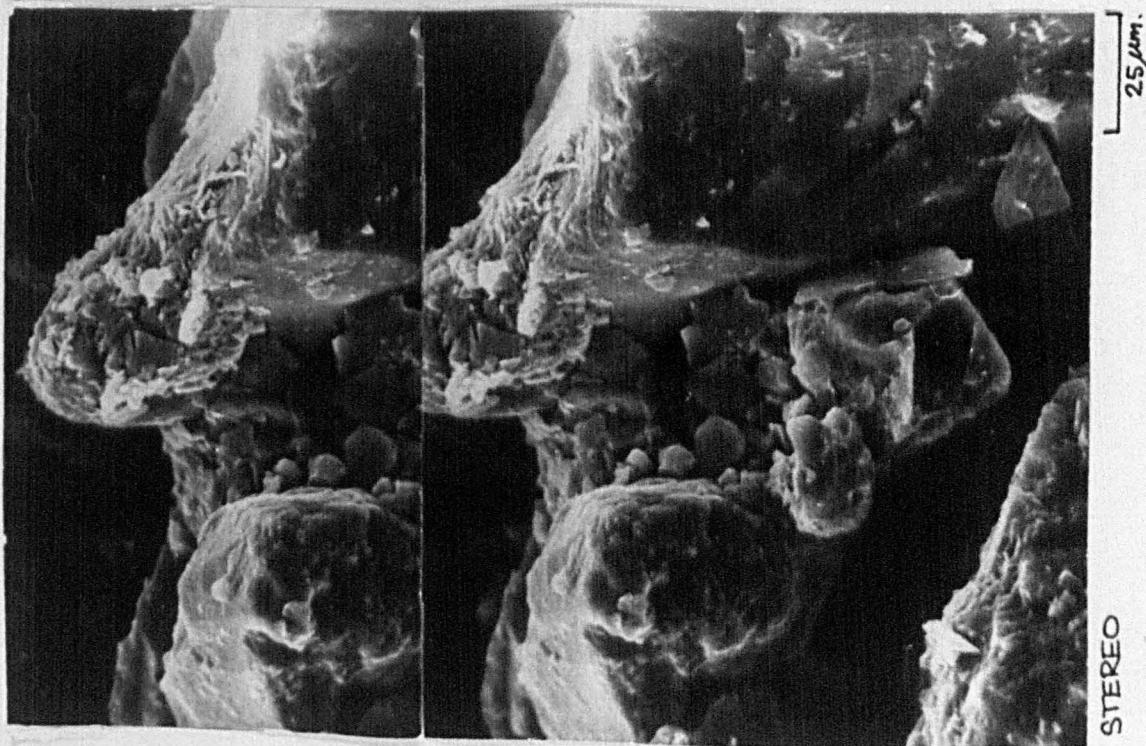
MIC. 43. GLEN ORCHY TILL - DISTRIBUTION OF COARSE AND FINE PARTICLES.

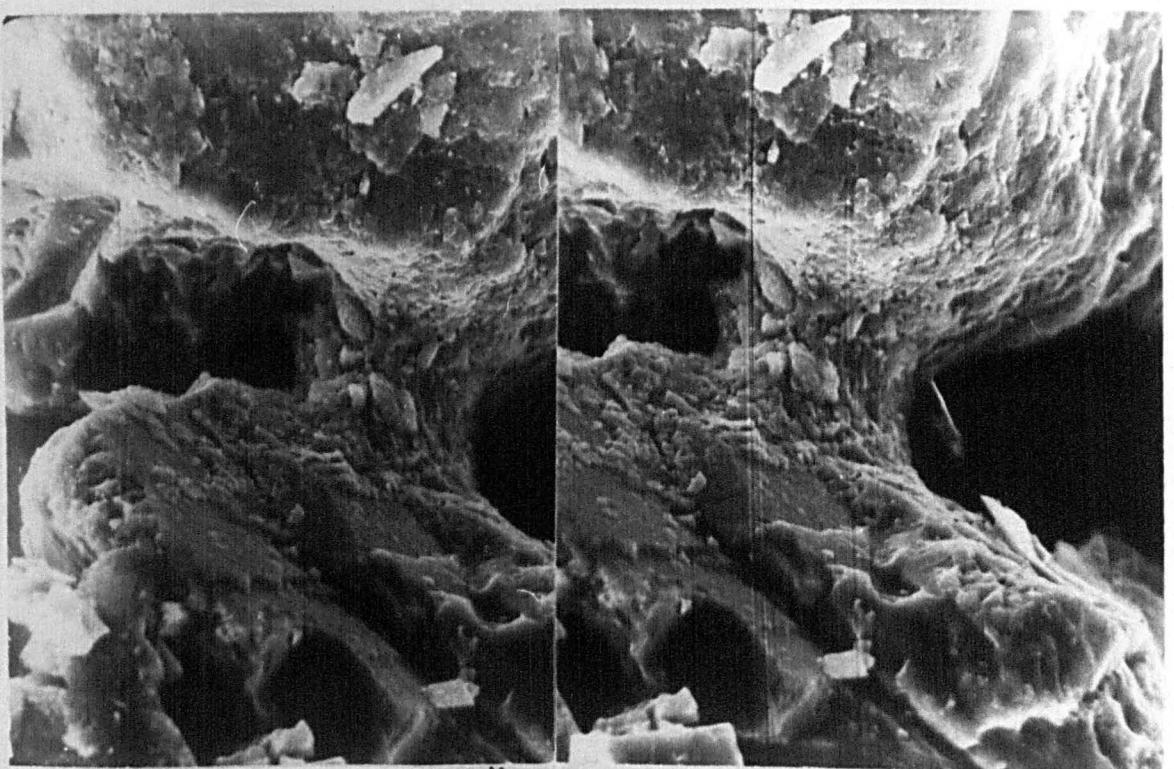
MIC. 44 - GLEN ORCHY TILL - COARSE GRAIN CONNECTOR.

(a)



(b)





MIC.45

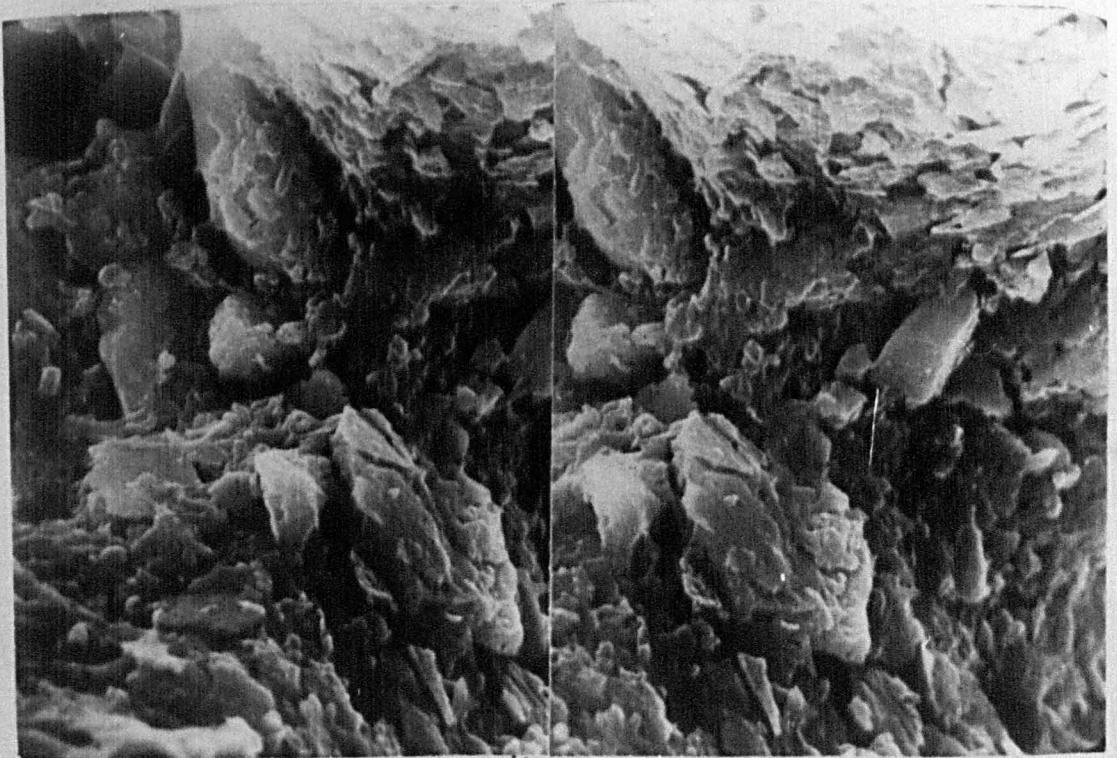
GLEN ORCHY TILL

FINE - PARTICLE

CONNECTOR.

STEREO.

2  $\mu$ m



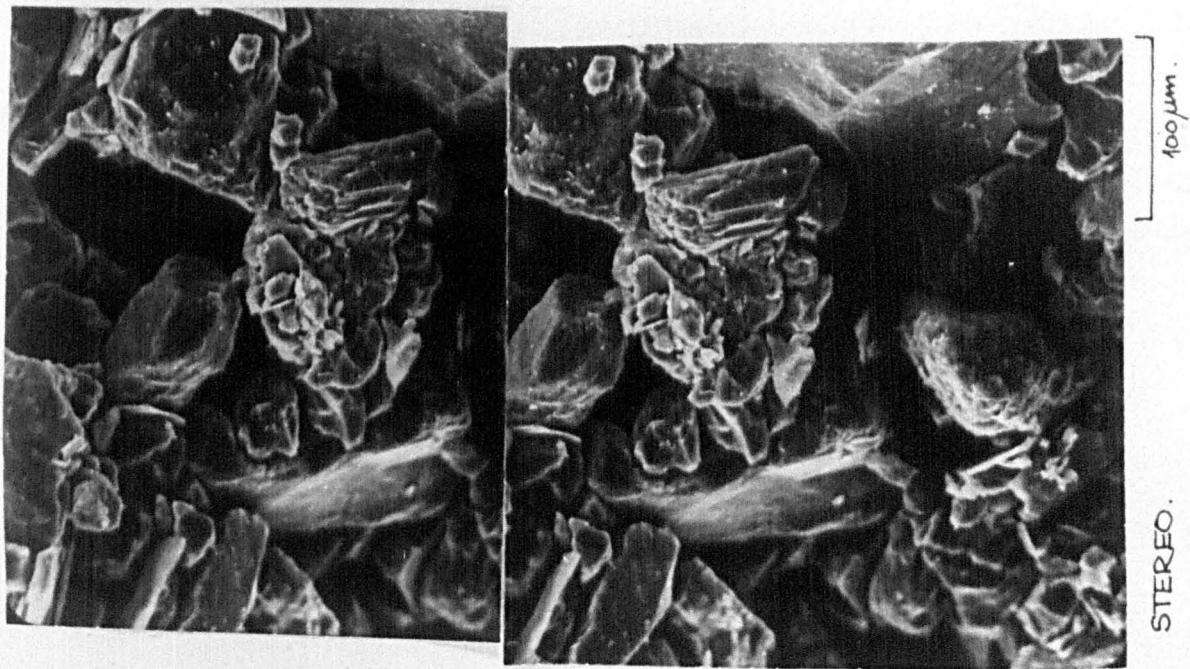
MIC.46.

GLEN ORCHY TILL

DETAIL OF MIC45

STEREO.

2  $\mu$ m

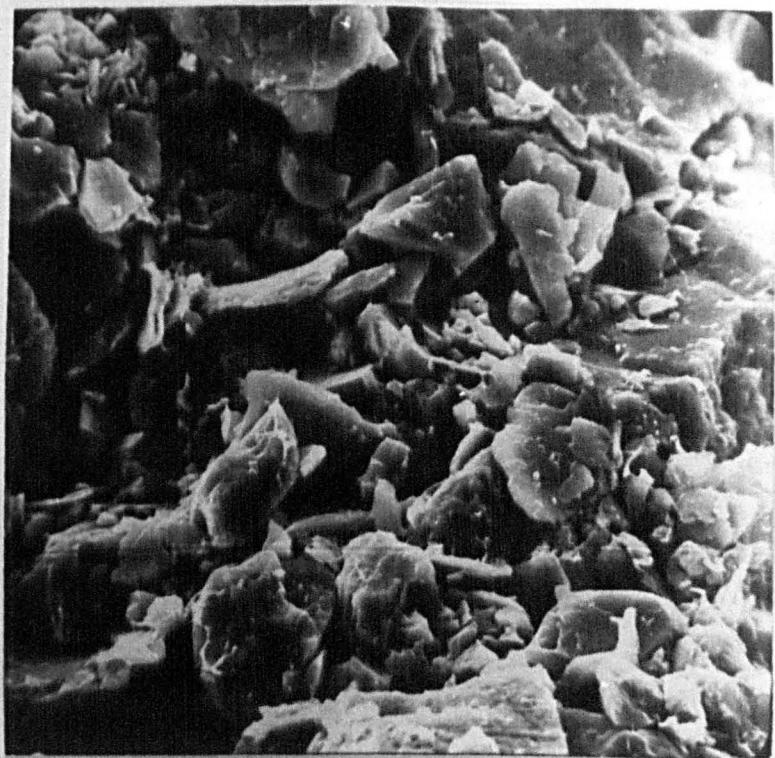


MIC. 47.

GLEN ORCHY TILL

- AGGREGATION ASSEMBLAGE

OF GRANULAR PARTICLES.



MIC. 48. GLEN ORCHY TILL - FINER

AREA OF MIC. 43.



MIC. 49 GLEN ORCHY TILL - DETAIL  
OF CLAY SIZE PARTICLES.