MET.O.14

METEOROLOGICAL OFFICE
BOUNDARY LAYER RESEARCH BRANCH
TURBULENCE & DIFFUSION NOTE

T.D.N. No. 64.

ANALYSIS OF SULPHATE & STRONG ACID DATA RECORDED AT 16 NORWEGIAN SITES DURING 1973.

by A. R. Parry and F. B. Smith

April 1975

The analysis of ground sampling station data: Norway 1973

Introduction. Sulphate measurements made at 16 regular Norwegian sampling sites during 1973* have been analysed in terms of the likely source region of the air. The results are presented as maps of sulphate concentration (annual average) for each of five categories of source area. The figures are based on actual precipitated sulphate measurements, and similar maps (not shown) were obtained of strong acid and rainfall amounts. These sources are not the only contributors to the total sulphate - for example Norway's own sources contribute to all the totals. The trajectories were based on those obtained during a study covering three years 1972-74.

Results. The figures show the annual average for each station for each source direction and interpolated contours. Table 1 gives areal averages over Norway south of 60°N. Note the large contribution to the sulphate in precipitation from purely oceanic sources, even though the sulphate of oceanic origin had been supposedly removed from the figures by reference to sodium and magnesium ion concentrations.

Table 1. Areal averages for five source regions.

SOURCE REGION	TOTAL SULPHATE g m^{-2}	% OF GRAND TOTAL
UK	0.744	31%
OCEANIC	0.640	27%
FRG+HOLLAND	0.534	22%
GDR+POLAND	0.315	13%
E+N.E.	0.160	7%
TOTAL	2.393	100%

If the ecological damage is done principally by high concentrations rather than by total amounts, then a rather different picture emerges, as shown in Table 2.

* These were made available by NILU.

Table 2. Total sulphate related to rainfall amount.

SOURCE REGION	TOTAL SULPHATE $g\ m^{-2}$	TOTAL RAINFALL mm	AVERAGE CONCENTRATION $mg\ l^{-1}$	FRACTION OF AVERAGE
FRG+HOLLAND	0.534	160	3.8	1.41
GDR+POLAND	0.315	96	3.4	1.26
UK	0.744	356	2.7	1.00
OCEANIC	0.640	375	2.2	0.81
E+N.E.	0.160	70	1.8	0.69

The overall average concentration was 2.7 $mg\ l^{-1}$.

Note that if the oceanic contribution can be assumed to apply as a background to trajectories crossing the UK as well, then the UK apparently increases the average concentration by only 0.5 $mg\ l^{-1}$. Note also that the total sulphate, total rain and average concentrations do not exactly satisfy the identity:

$$\text{av. conc} = \frac{\text{total sulphate}}{\text{total rain}}$$

due to the rather subjective way contours were drawn and areal averages determined.

The picture with regard to strong acid is again rather different. Only the days when the precipitation was actually acidic have been included in the analysis. The alkaline cases usually occurred during the two trajectory classes "UK" and "FRG+Holland". This is seen most clearly from the rainfall figures in Table 3. The biggest difference occurred well away from the SW coast, which so far has been unexplained. The units of strong acid are in micro-equivalents per m^2, where 1 micro-equivalent = 16 μg sulphur.

Table 3. Total strong acid and rainfall

SOURCE REGION	TOTAL RAINFALL mm	ACIDIC RAINFALL mm	TOTAL STRONG ACID μeq m^{-2}	% OF GRAND TOTAL
UK	356	290	14000	39
FRG+HOLLAND	160	138	10000	28
OCEANIC	375	375	6000	17
GDR+POLAND	96	96	4000	11
E+NE	70	70	2000	5

As with the sulphate concentrations, we again see a re-ordering of the list when we consider the average concentrations. (Table 4).

Table 4. Strong acid related to rainfall amount

SOURCE REGION	TOTAL STRONG ACID	TOTAL ACID RAINFALL mm	CONCENTRATION OF ACID μeq l^{-1}	FRACTION OF AVERAGE *
FRG+HOLLAND	10000	138	70	1.75
GDR+POLAND	4000	96	42.4	1.06
UK	14000	290	40.8	1.02
OCEANIC	6000	375	26.0	0.65
E+NE	2000	70	23.1	0.58

* The average concentration was 40.1 μeq l^{-1}.

The maps showing the distribution of the strong acid show marked local maxima along the southern Norwegian coastline from Flekkefjord through Kristiansand to Larvik, which suggests the effect of local industry.

Comparison of the model calculations with the measurements.

The dry and wet deposition amounts calculated by the trajectory and emission model for 1973 were grouped into regions corresponding to the trajectory source areas used in the analysis of the sulphate measurements (with the exception of the "Oceanic" region, which has no equivalent in the model). The actual dry deposition was estimated from measurements of SO_2 in air at the five relatively complete Norwegian sampling stations shown in the inset. These measurements were analysed in the same way as the sulphate measurements, with respect to trajectory origin, and the dry deposition was calculated from the mean concentration of the five stations using a deposition velocity of 8 mm s^{-1}. Table 5 shows the results of the SO_2 analysis, and Table 6 is a comparison of the model results with the measured values.

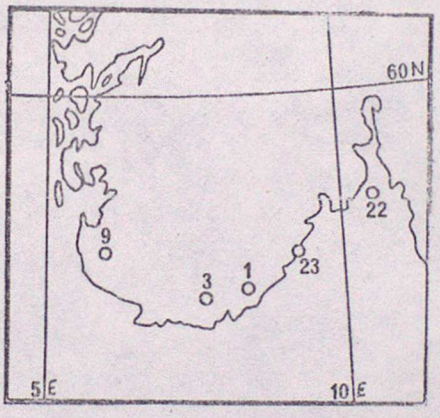


Table 5. SO_2 mean concentrations

SOURCE REGION	FREQUENCY %	SO_2 CONCENTRATION $\mu g\ m^{-3}$
OCEANIC	54.2	3.7
UK	22.2	5.2
E + NE	9.9	4.1
GDR+POLAND	7.1	8.1
FRG+HOLLAND	6.6	9.3

Table 6. Comparison of model calculation with measurements.

Units: $g\ m^{-2}$

SOURCE REGION	DRY DEPOSITION		DEPOSITION IN RAIN	
	MEASUREMENT	MODEL	MEASUREMENT	MODEL
OCEANIC	0.505	-	0.427	-
UK AND PART OF NORWAY	0.291	0.224	0.496	0.578
USSR, FINLAND, SWEDEN AND PART OF NORWAY	0.102	0.088	0.107	0.203
GDR, POLAND, CZECH., DENMARK & PART OF NORWAY	0.145	0.134	0.210	0.310
FRG, HOLLAND, BELGIUM, FRANCE & PART OF NORWAY	0.155	0.110	0.356	0.402

On the whole the agreement is good, particularly in a relative sense between source areas, although the model appears to somewhat underestimate dry deposition and over-estimate wet deposition. These systematic differences could arise from a variety of causes, principal of which are:

(i) The measured concentrations of SO_2 at the five sites may be larger than average over the whole of S. Norway below $60^{\circ}N$ because of the concentration of the population and industry in the surrounding coastal regions

(ii) The values of dry deposition and conversion to sulphate used in the model may be in error, but as previously noted the model results are not particularly sensitive to reasonable variations in these parameters.

These differences should not however mask the overall agreement and apparent success of the trajectory model and hence the significance of the implied contributions from the major source areas of Europe.

The one major question mark must remain the contribution from the apparently oceanic sources and whether this is relevant to the acidity of Norway's waters.

(11,960)
744

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : "A" United Kingdom

Year : 1973

TOTAL SULPHATE

Av. = 0.774 g/m²
(312)

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m

Sulphate :-

Plot indicator

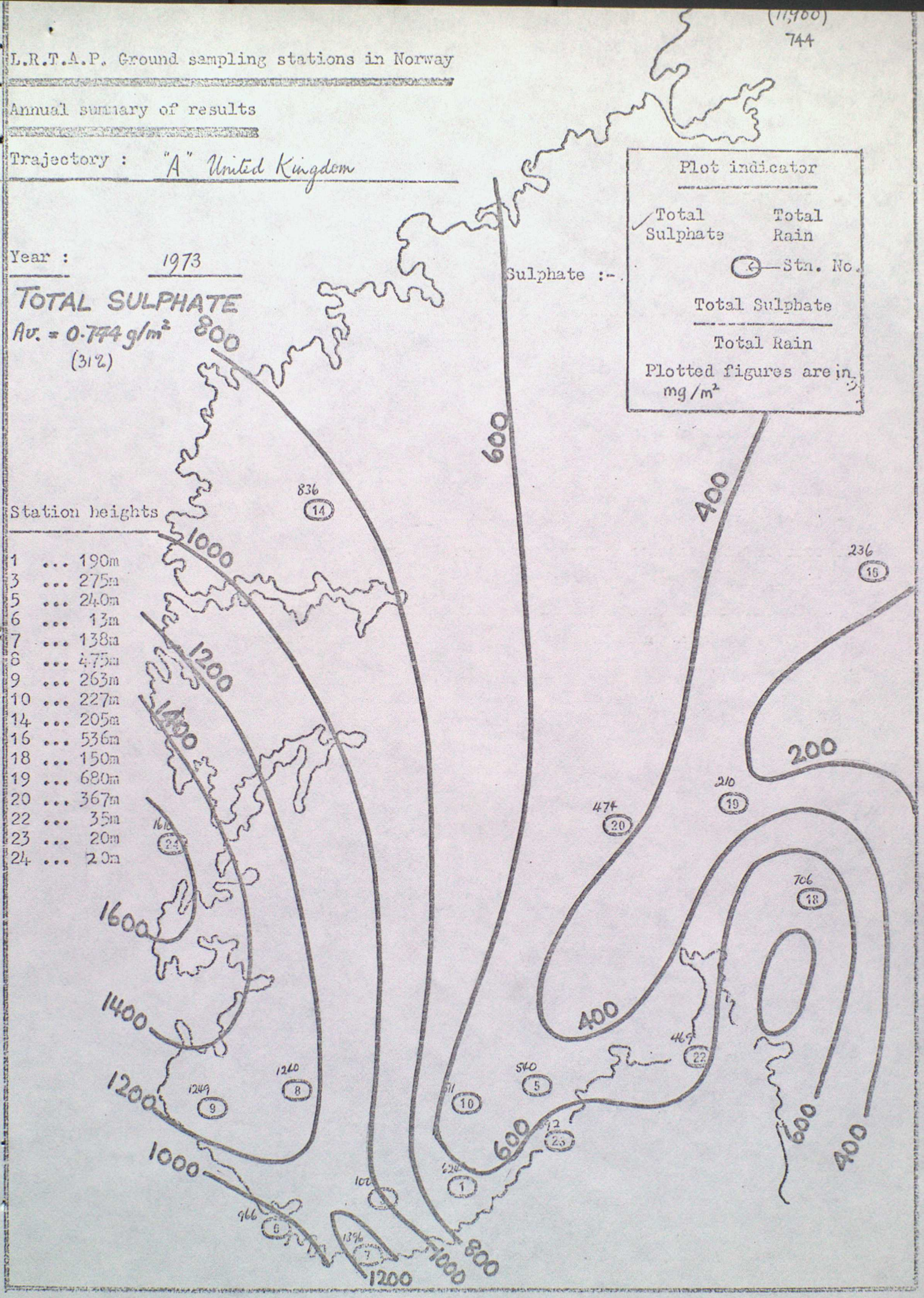
Total Sulphate / Total Rain

Stn. No.

Total Sulphate

Total Rain

Plotted figures are in mg/m²



$\bar{C}$ = 2·7

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : "A" United Kingdom

Year : 1973

CONC. SULPHATE
$\bar{C}$ = 2·7 mg/litre

Plot indicator

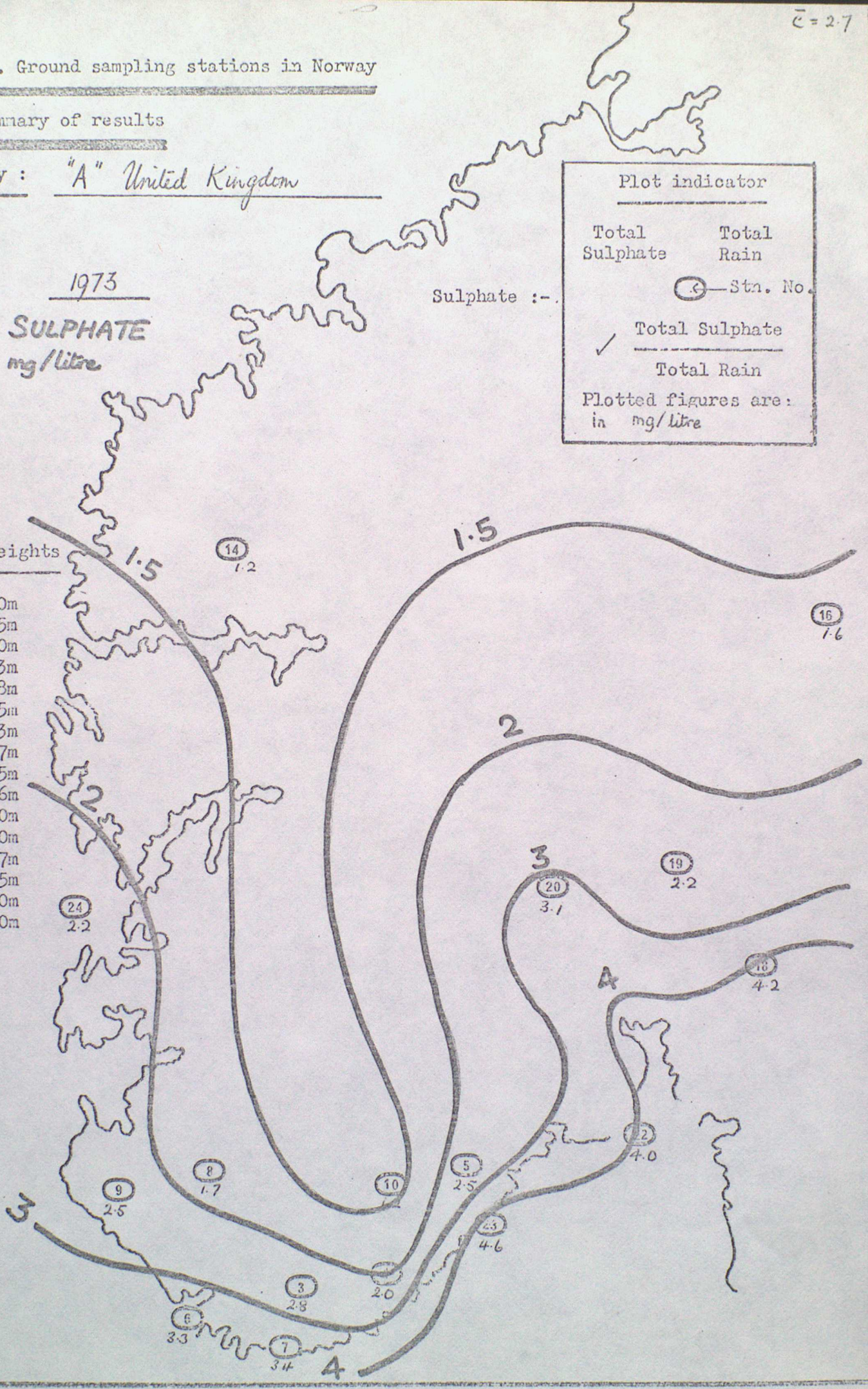
Total Sulphate / Total Rain — Stn. No.

Plotted figures are: in mg/litre

Sulphate :-

Station heights

1 ... 190m
3 ... 275m
5 ... 240m
6 ... 13m
7 ... 138m
8 ... 475m
9 ... 263m
10 ... 227m
14 ... 205m
16 ... 536m
18 ... 150m
19 ... 680m
20 ... 367m
22 ... 35m
23 ... 20m
24 ... 2.0m



(5,700)
356

L.R.T.A.P. Ground sampling stations in Norway

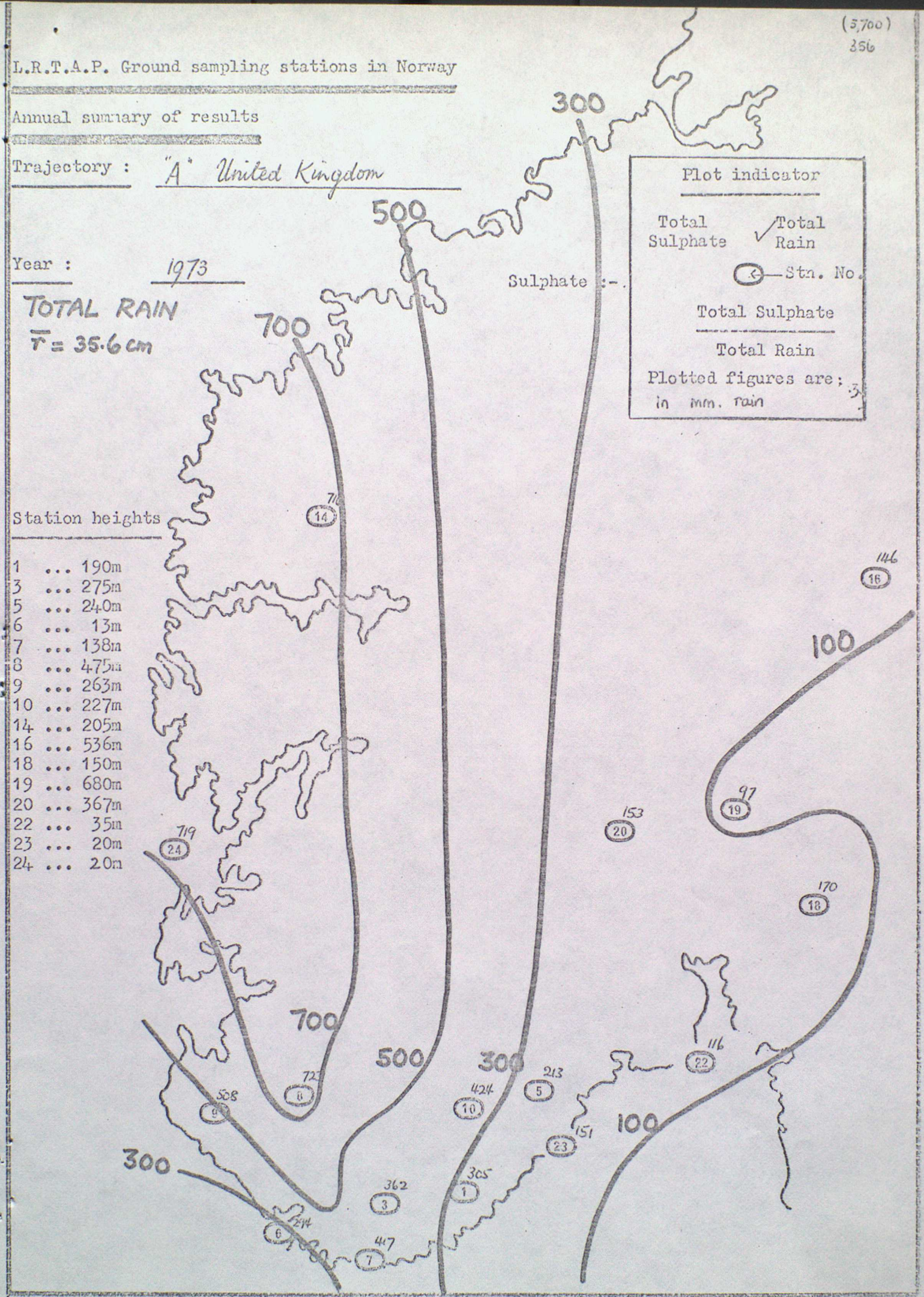
Annual summary of results

Trajectory : "A" United Kingdom

Year : 1973

TOTAL RAIN

$\bar{r}$ = 35.6 cm



Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m

(8550)
534

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'B' HOLLAND AND RUHR.

Year : 1973.

TOTAL SULPHATE

Av = 0·534 g/m²

(22%)

Sulphate :-

Plot indicator

✓ Total Sulphate — Total Rain

(x) — Stn. No.

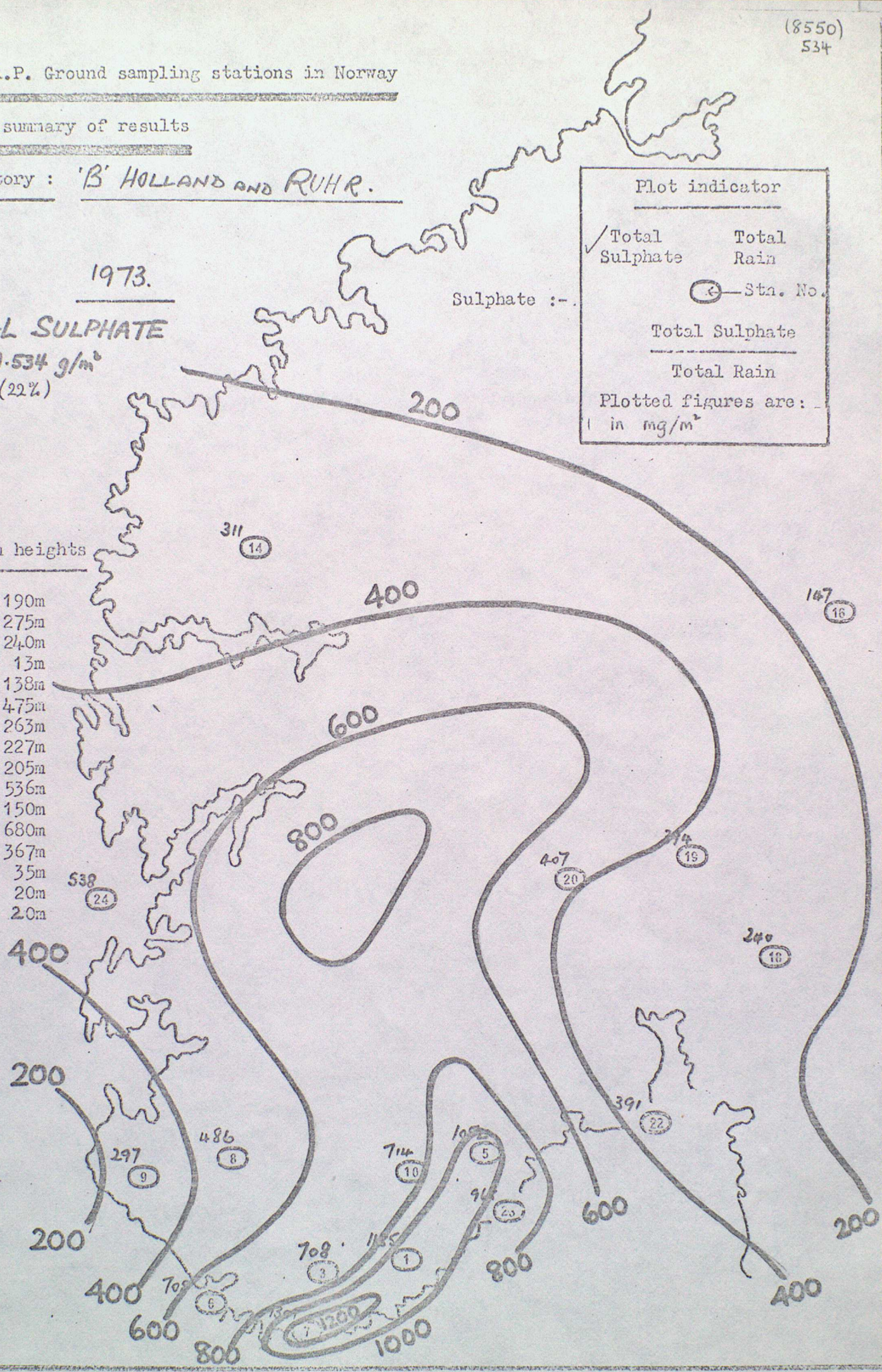
Total Sulphate

Total Rain

Plotted figures are: in mg/m²

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m



$\bar{C} = 3.8$

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'B' HOLLAND AND RHUR

Year : 1973.

CONC. SULPHATE

$\bar{C} = 3.8$ mg/litre

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m

Plot indicator

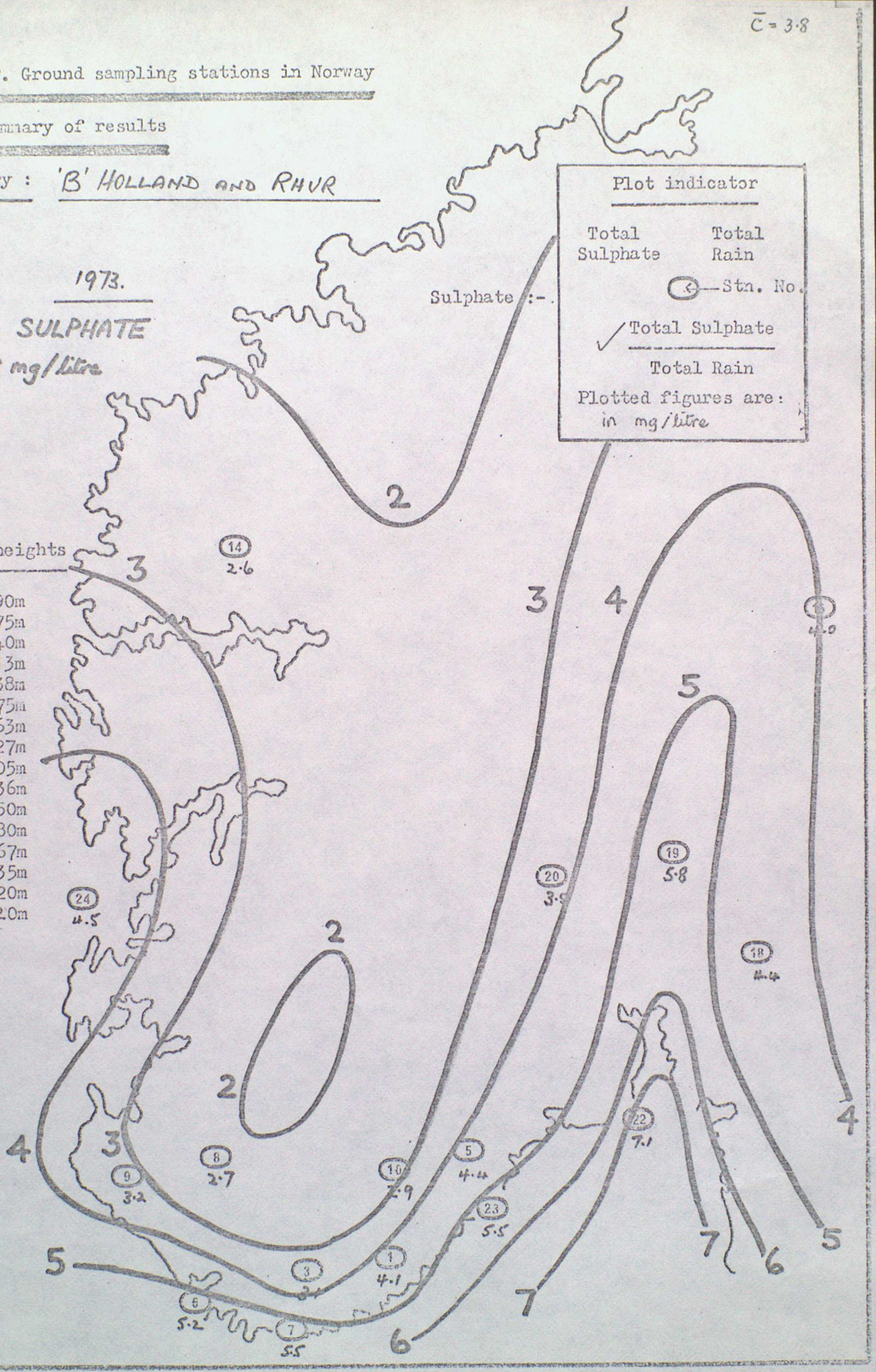
Total Sulphate / Total Rain

Stn. No.

Total Sulphate / Total Rain

Plotted figures are: in mg/litre

Sulphate :-



(2560)
160

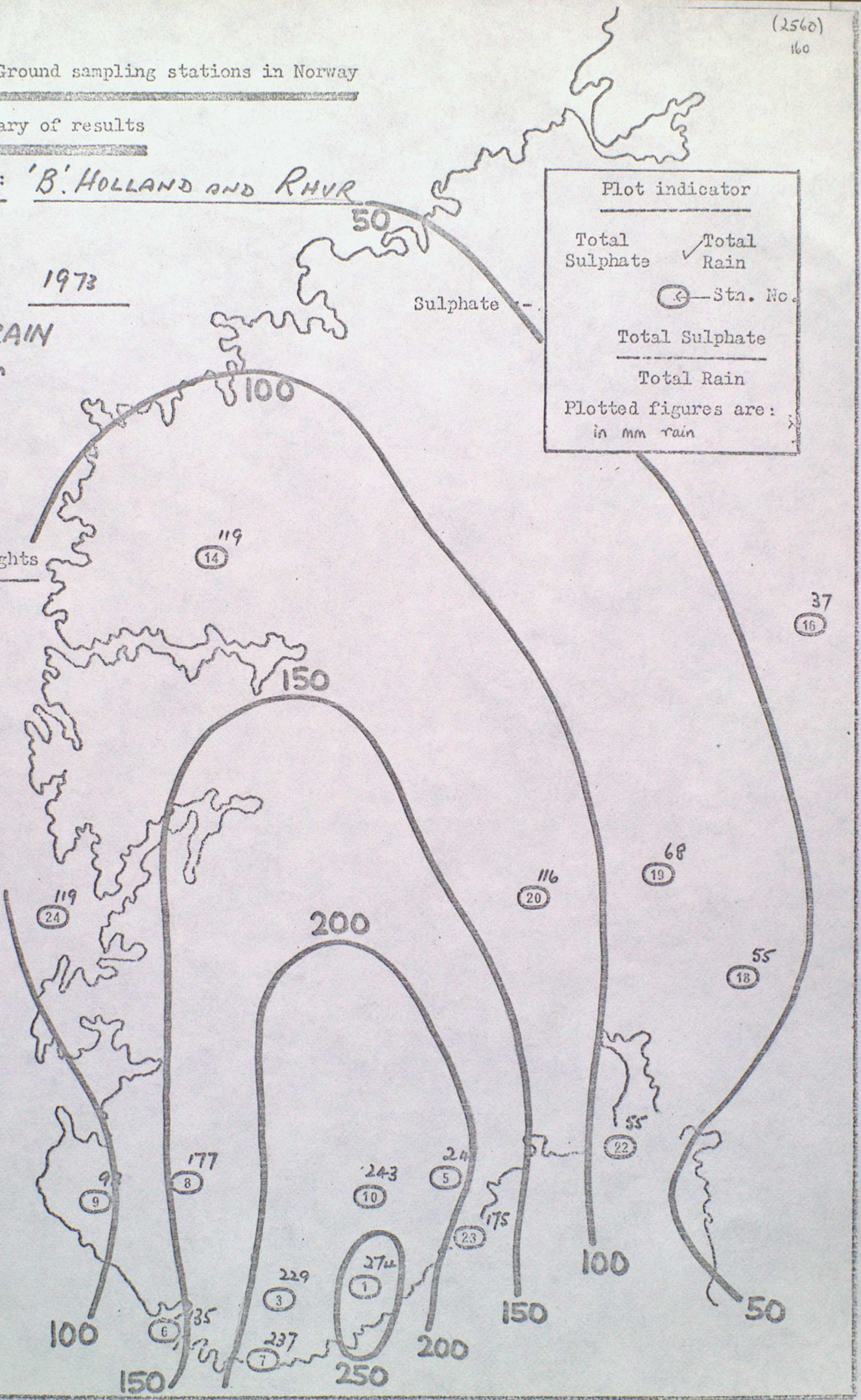
L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'B'. HOLLAND AND RHUR

Year : 1973

TOTAL RAIN
$\bar{r}$ = 16 cm



Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'C' E. GERMANY AND POLAND

Year : 1973

TOTAL SULPHATE

Av. = 0.315 g/m²

(13%)

Plot indicator

Total Sulphate — Total Rain

Stn. No.

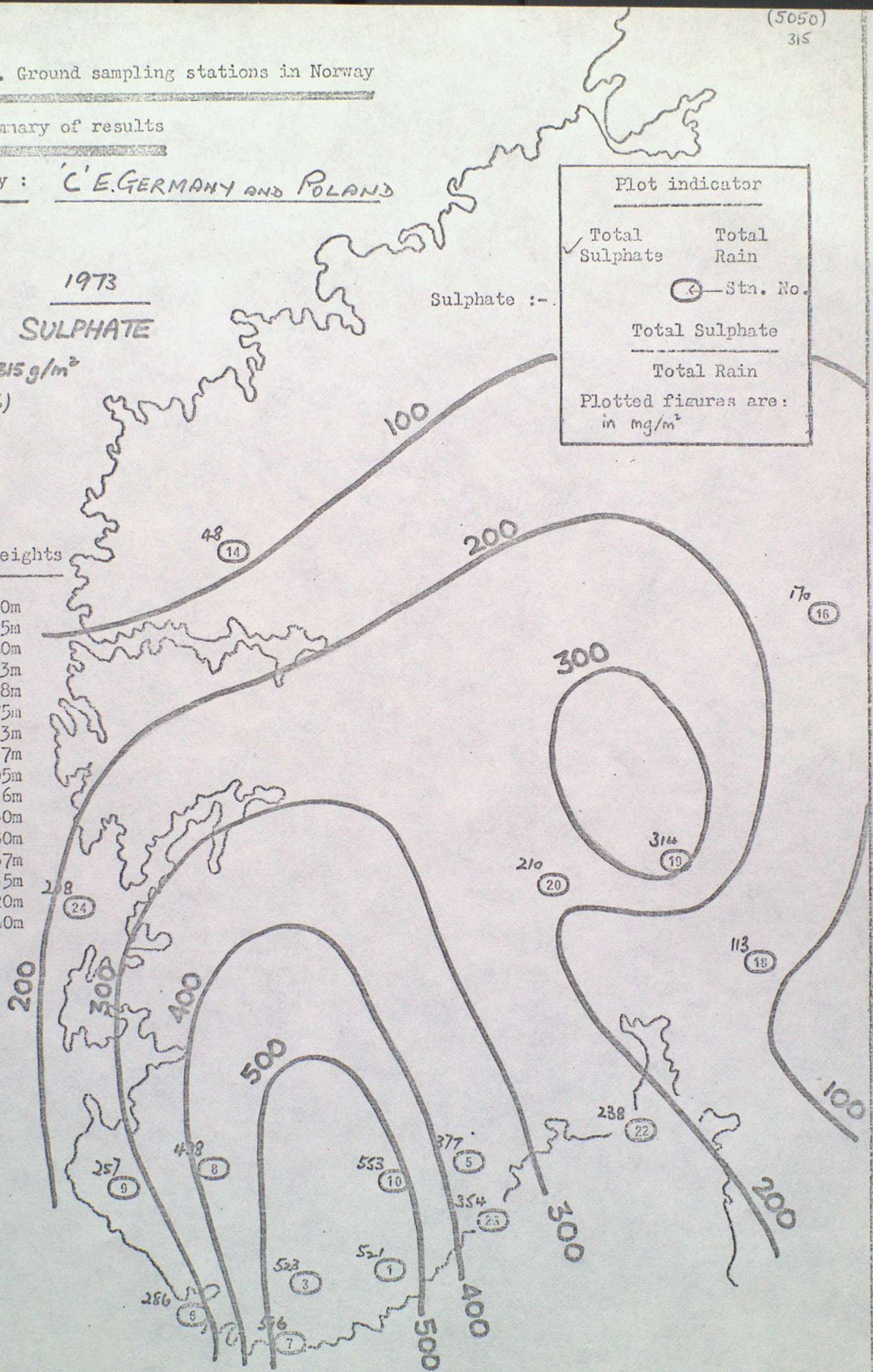
Total Sulphate / Total Rain

Plotted figures are: in mg/m²

Sulphate :-

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m



(1540)
96

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'C' E. GERMANY AND POLAND.

Year : 1973

TOTAL RAIN

$\bar{r}$ = 9.6 cm

Sulphate :-

Plot indicator

Total Sulphate / Total Rain

Stn. No.

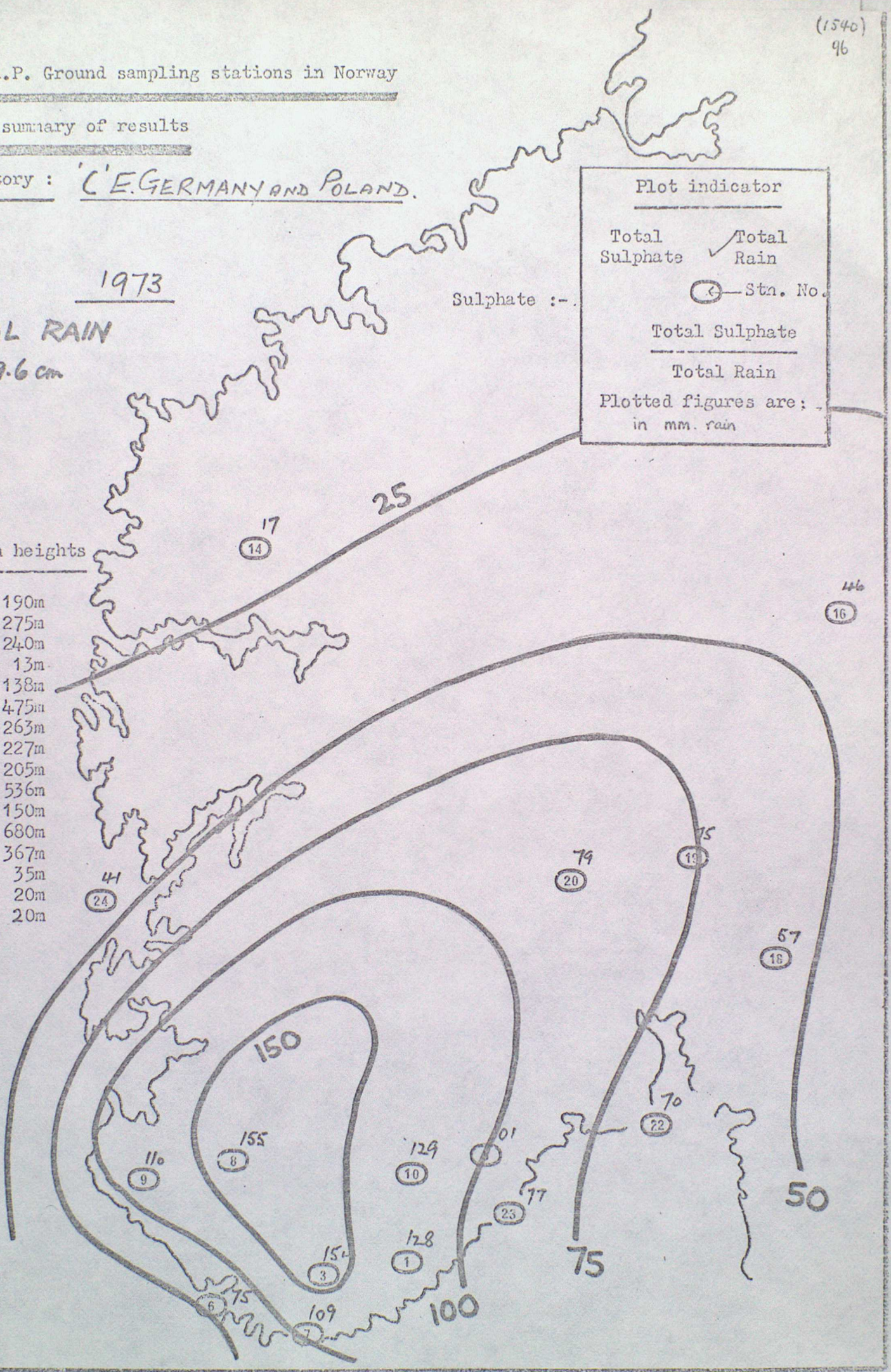
Total Sulphate

Total Rain

Plotted figures are: in mm. rain

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m



$\bar{C} = 3.4$

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'C' E. GERMANY AND POLAND

Year : 1973

Conc. Sulphate

$\bar{C} = 3.4$ mg/litre

Sulphate :-

Plot indicator

Total Sulphate / Total Rain

Stn. No.

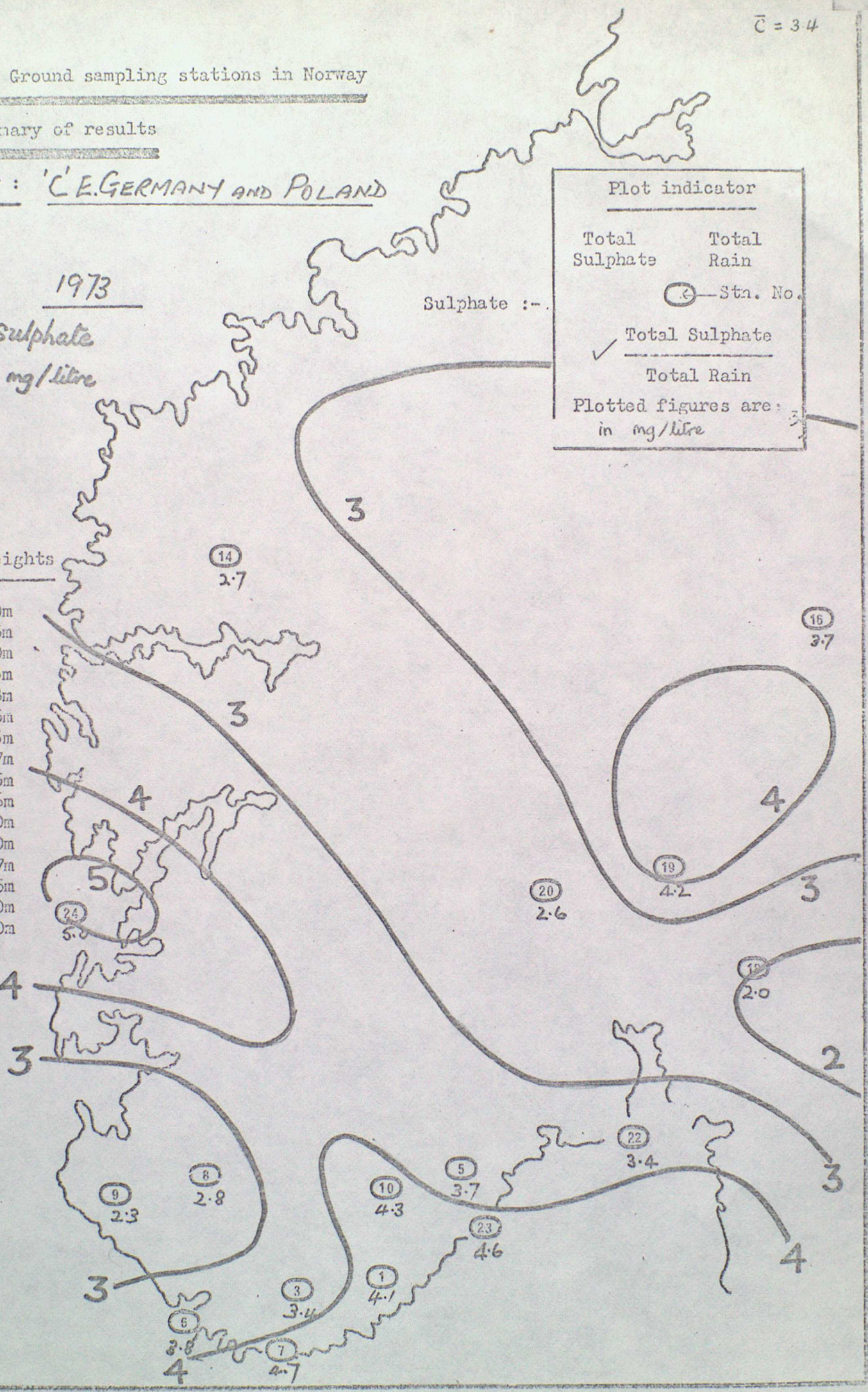
Total Sulphate

Total Rain

Plotted figures are in mg/litre

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m



(10,250)
640

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'D' OCEANIC.

Year : 1973

TOTAL SULPHATE
Av. = 0.64 g/m²
(27%)

Station heights

1 ... 190m
3 ... 275m
5 ... 240m
6 ... 13m
7 ... 138m
8 ... 475m
9 ... 263m
10 ... 227m
14 ... 205m
16 ... 536m
18 ... 150m
19 ... 680m
20 ... 367m
22 ... 35m
23 ... 20m
24 ... 120m

Sulphate :-

Plot indicator

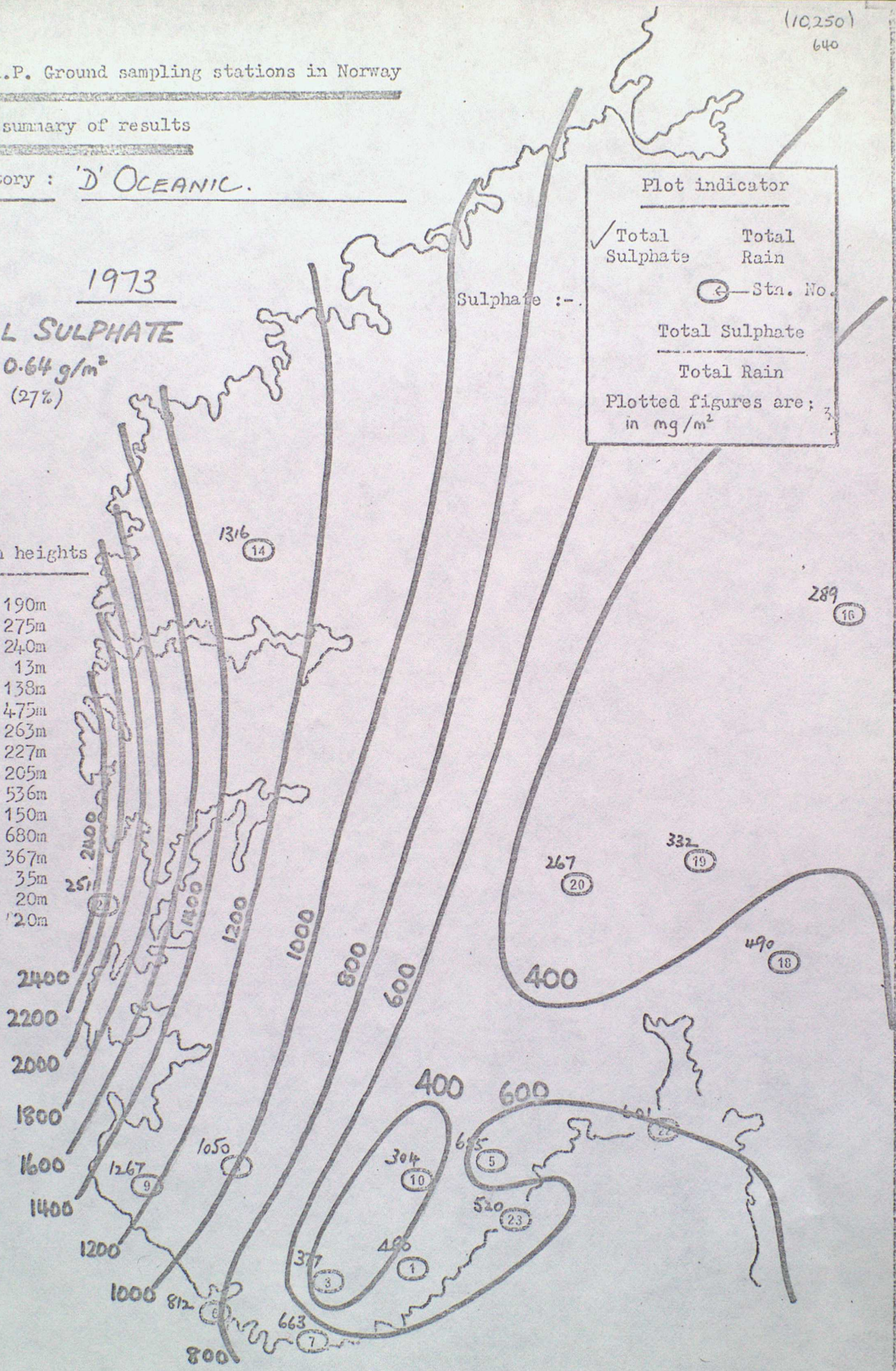
✓ Total Sulphate — Total Rain

(14) — Stn. No.

Total Sulphate

Total Rain

Plotted figures are; in mg/m²



(6000)
375

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'D' OCEANIC.

Year : 1973

TOTAL RAIN

$\bar{r}$ = 37.5 cm

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m

Sulphate :-

Plot indicator

Total Sulphate | Total Rain

Stn. No.

Total Sulphate

Total Rain

Plotted figures are; in mm. rain

1500 1300 1100 900 700 500 300 200

1184 (14)
262 (16)
853 (24)
137 (20)
170 (19)
200 (18)
1100
900
700
500
300
200
178 (8)
(9)
250 (5)
182 (10)
163 (23)
160 (22)
176 (1)
32 (3)
285 (6)
317 (7)

$\bar{C}$ = 2·2

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'D' OCEANIC.

Year : 1973.

Conc. Sulphate

$\bar{C}$ = 2·2 mg/litre

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m

Sulphate :-

Plot indicator

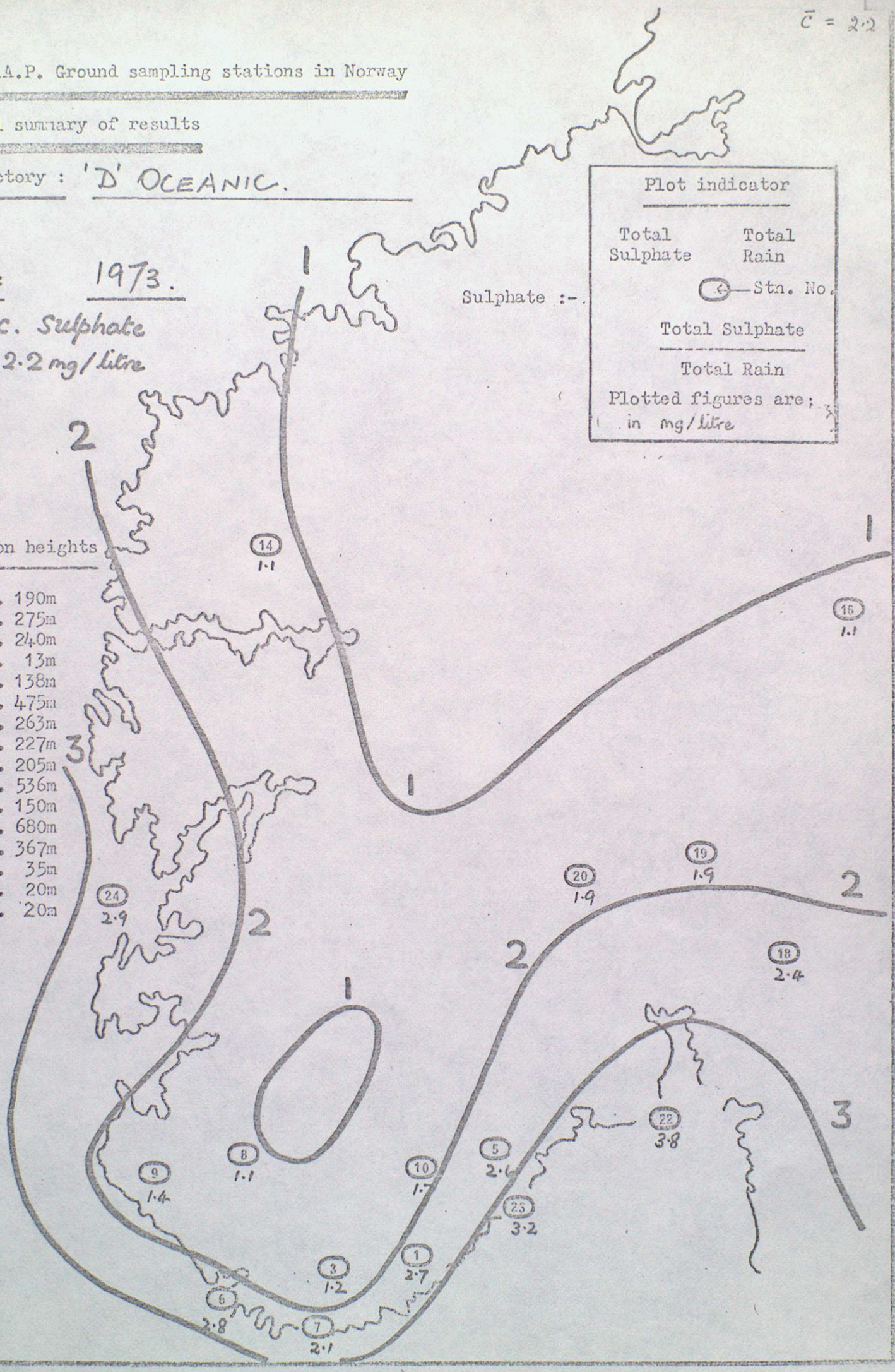
Total Sulphate | Total Rain

Stn. No.

Total Sulphate

Total Rain

Plotted figures are; in mg/litre



(2560)
160

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'E' E. AND NORTHEAST TRAJECTORIES

Year : 1973

TOTAL SULPHATE

Av. = 0.16 g/m²
(7%)

Sulphate :-

Plot indicator

✓ Total Sulphate — Total Rain

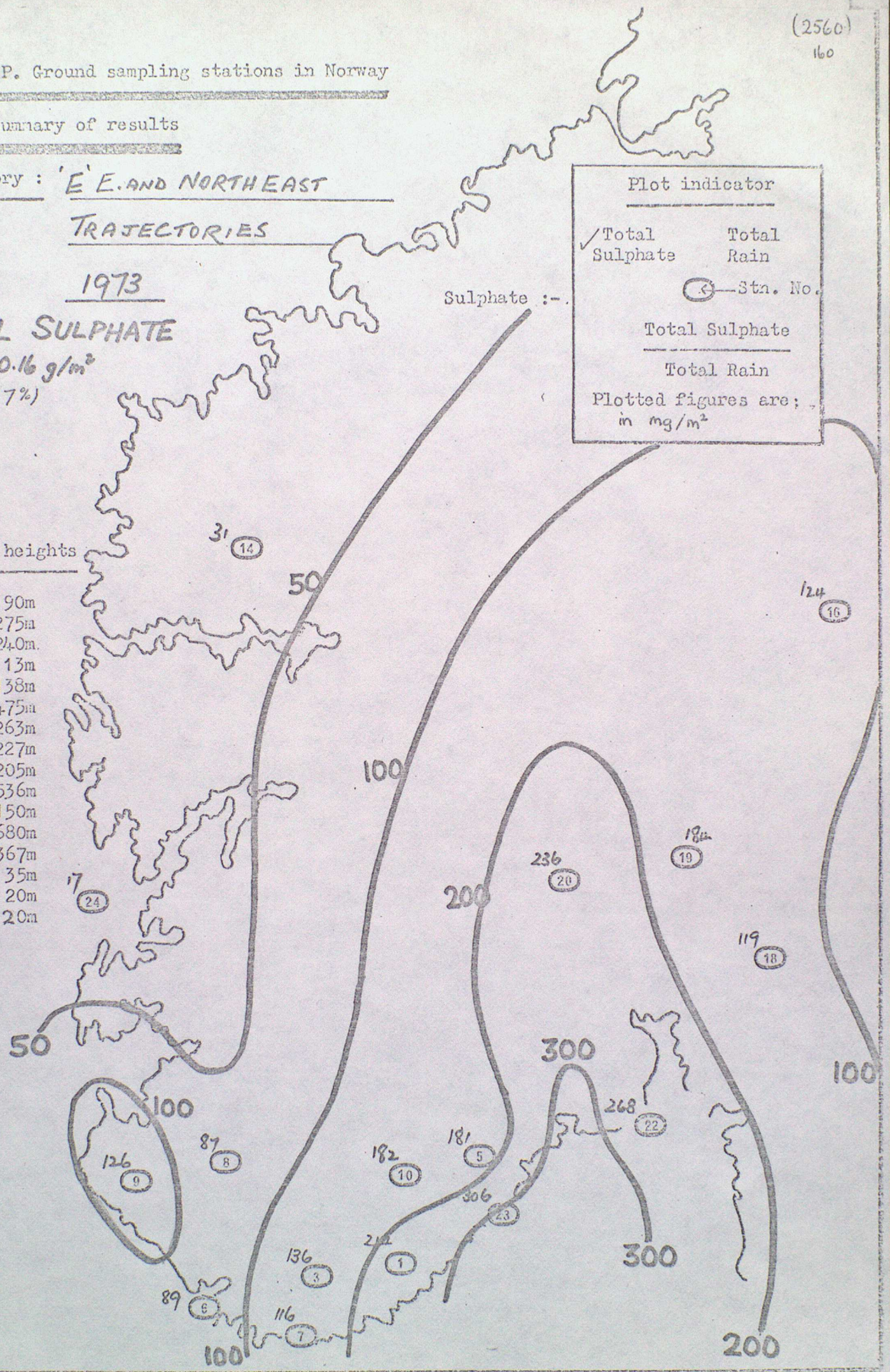
(4) — Stn. No.

Total Sulphate / Total Rain

Plotted figures are; in mg/m²

Station heights

1	...	190m
3	...	275m
5	...	240m.
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m



(1130)
70

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'E' EAST AND NORTH EAST TRAJECTORIES.

Year : 1973

TOTAL RAIN
$\bar{r}$ = 7 cm.

Sulphate :-

Plot indicator

Total Sulphate ✓Total Rain

(x)—Stn. No.

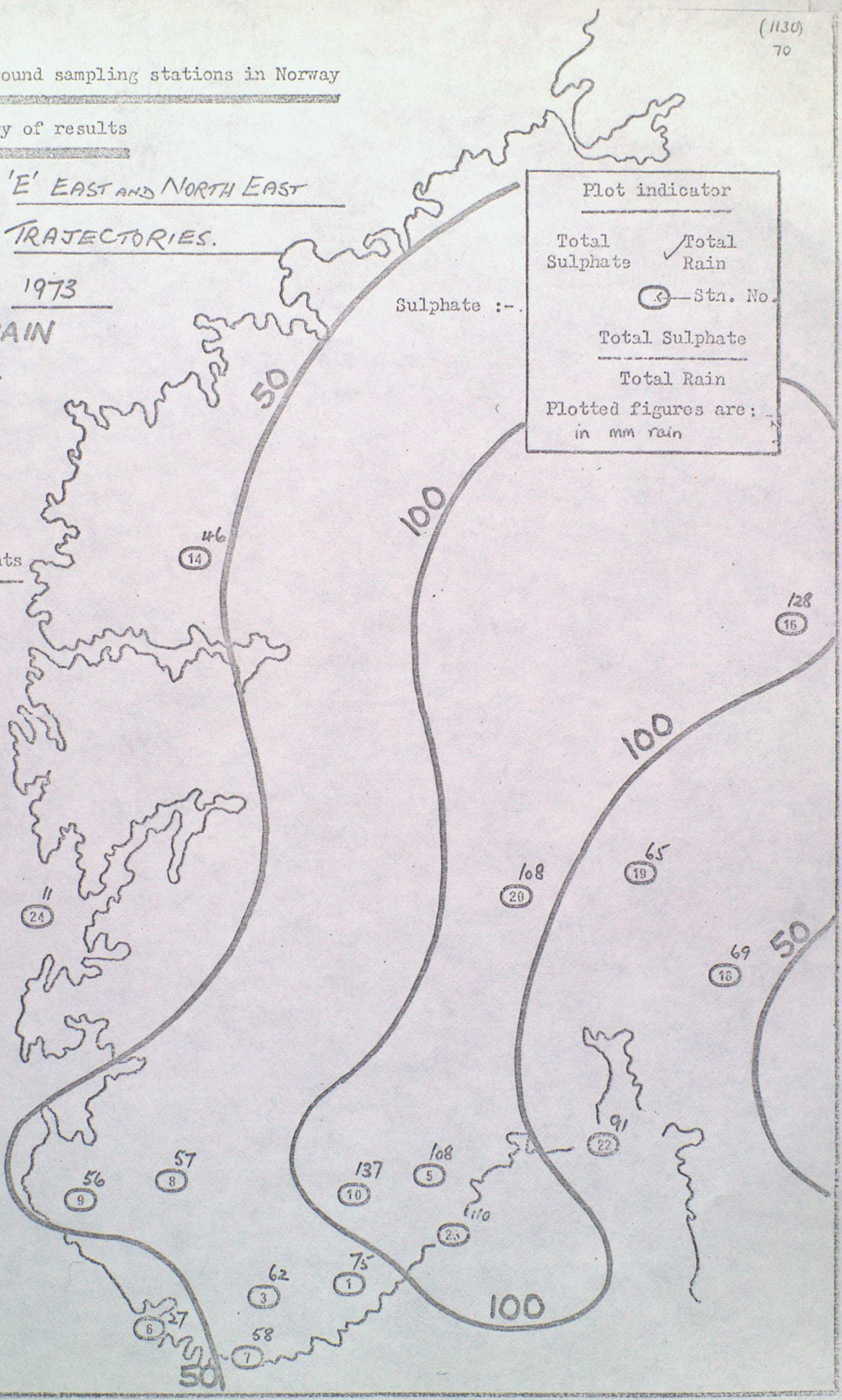
Total Sulphate

Total Rain

Plotted figures are: in mm rain

Station heights

1 ... 190m
3 ... 275m
5 ... 240m
6 ... 13m
7 ... 138m
8 ... 475m
9 ... 263m
10 ... 227m
14 ... 205m
16 ... 536m
18 ... 150m
19 ... 680m
20 ... 367m
22 ... 35m
23 ... 20m
24 ... 20m



$\bar{C}$ = 1·85

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'E' EAST AND NORTH EAST TRAJECTORIES

Year : 1973

CONC. SULPHATE

$\bar{C}$ = 1·85 mg/litre

Plot indicator

Total Sulphate / Total Rain

Stn. No.

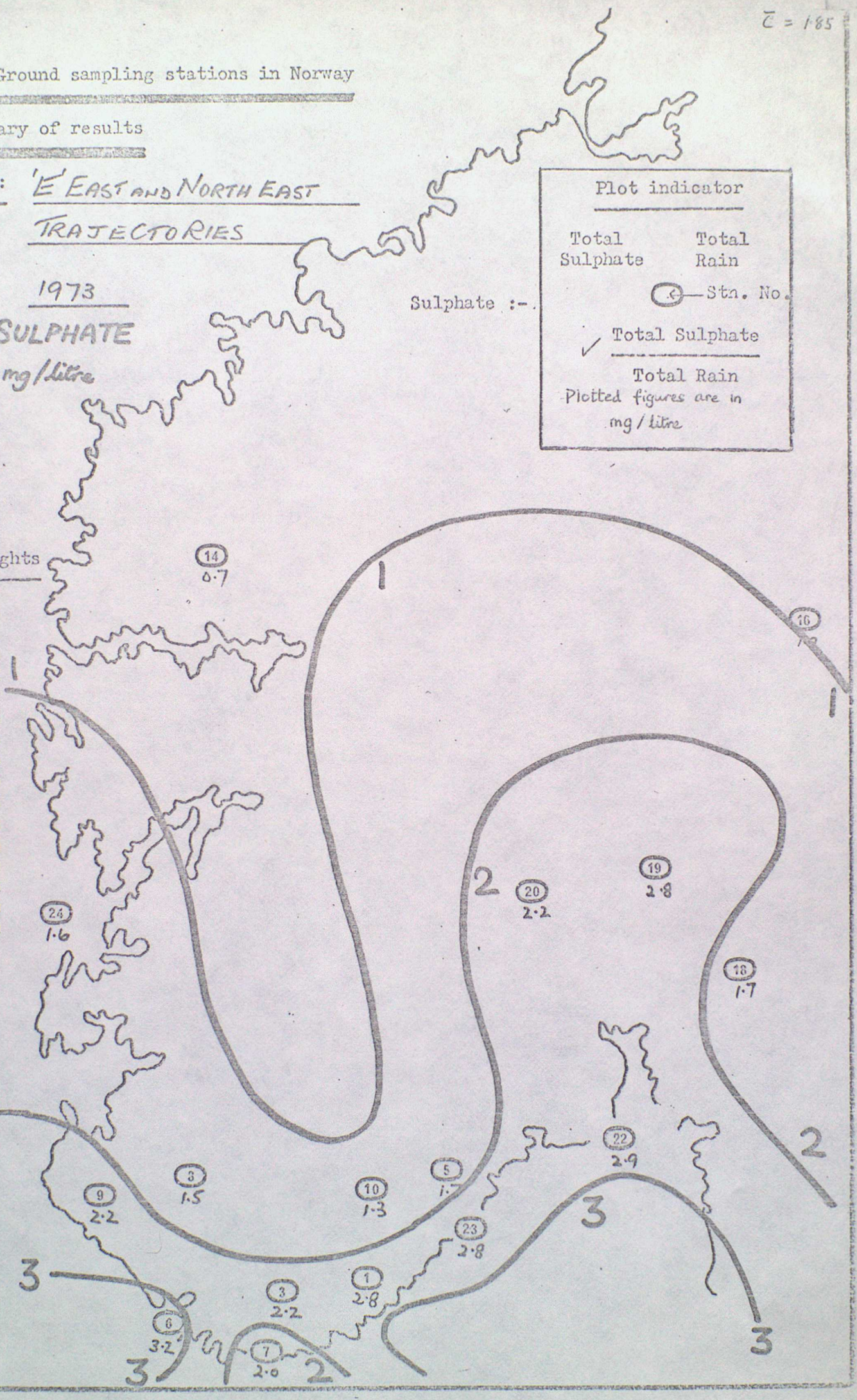
Total Sulphate / Total Rain

Plotted figures are in mg/litre

Sulphate :-

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m



L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : "A" United Kingdom

Year : 1973

TOTAL STRONG ACID
(during "acid" periods)
Av. = 14

Plot indicator

Total Strong Acid — Total Rain

Stn. No.

Total strong acid

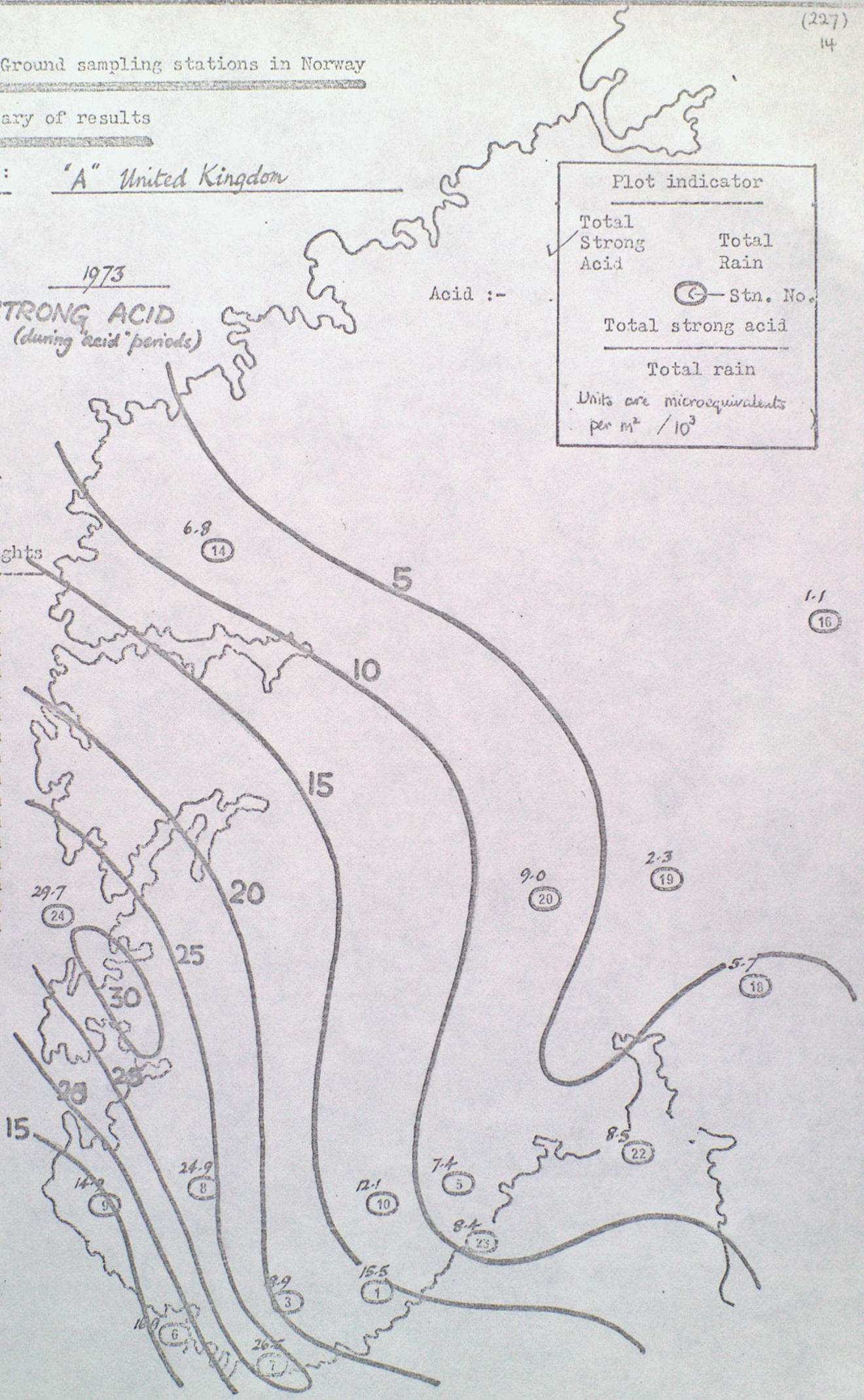
Total rain

Units are microequivalents per m^2 / 10^3

Acid :-

Station heights

1 ... 190m
3 ... 275m
5 ... 240m
6 ... 13m
7 ... 138m
8 ... 475m
9 ... 263m
10 ... 227m
14 ... 205m
16 ... 536m
18 ... 150m
19 ... 680m
20 ... 367m
22 ... 35m
23 ... 20m
24 ... 20m



L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : "A" United Kingdom

Year : 1973

CONC. STRONG ACID

$\bar{C}$ = 40.8

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m

Plot indicator

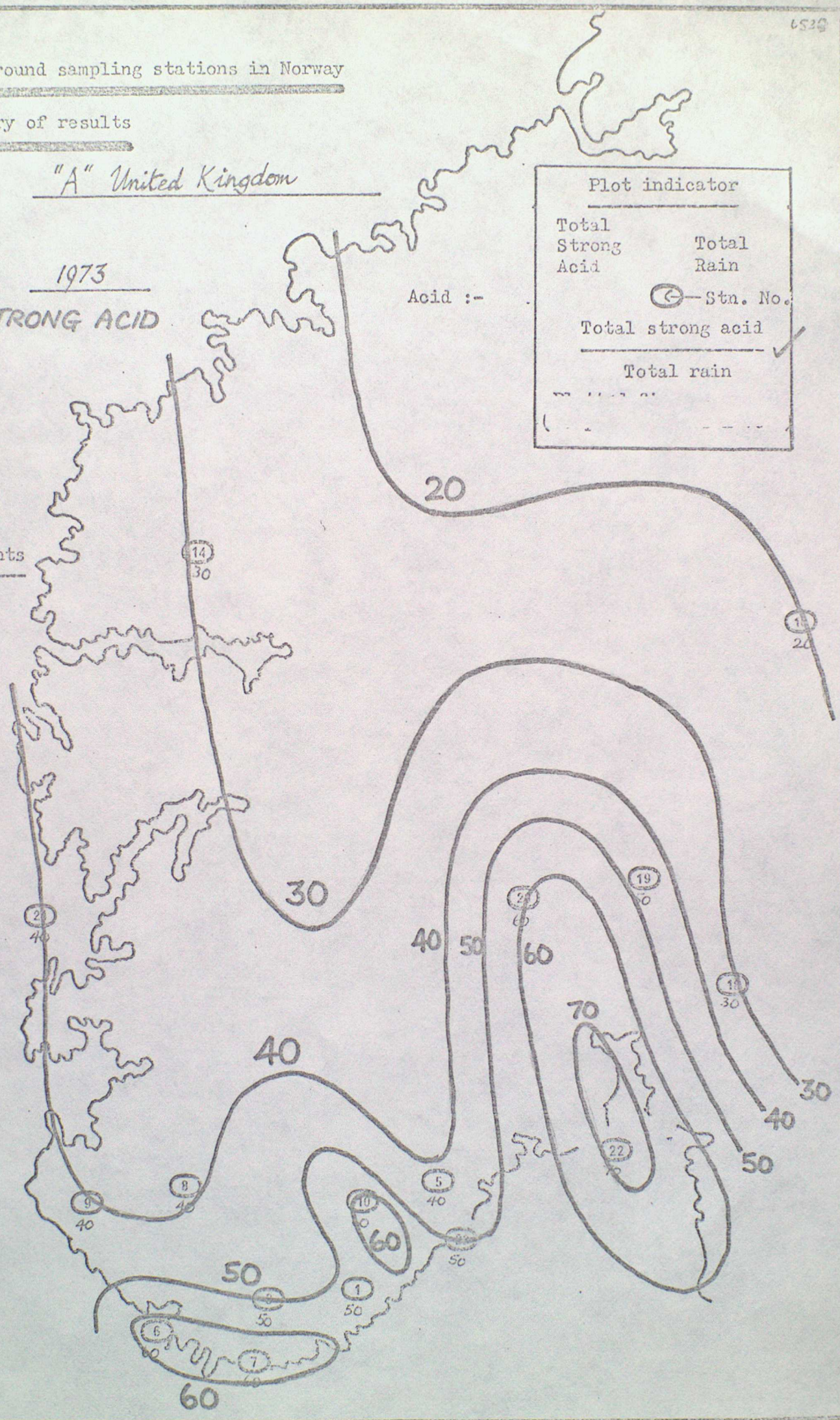
Total Strong Acid — Total Rain

Stn. No.

Total strong acid

Total rain

Acid :-



L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : "A" United Kingdom

RAIN

Year : 1973

TOTAL RAIN
(during "acid" periods)

$\bar{r}$ = 29 cm

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m

Plot indicator

Total Strong Acid — Total Rain ✓

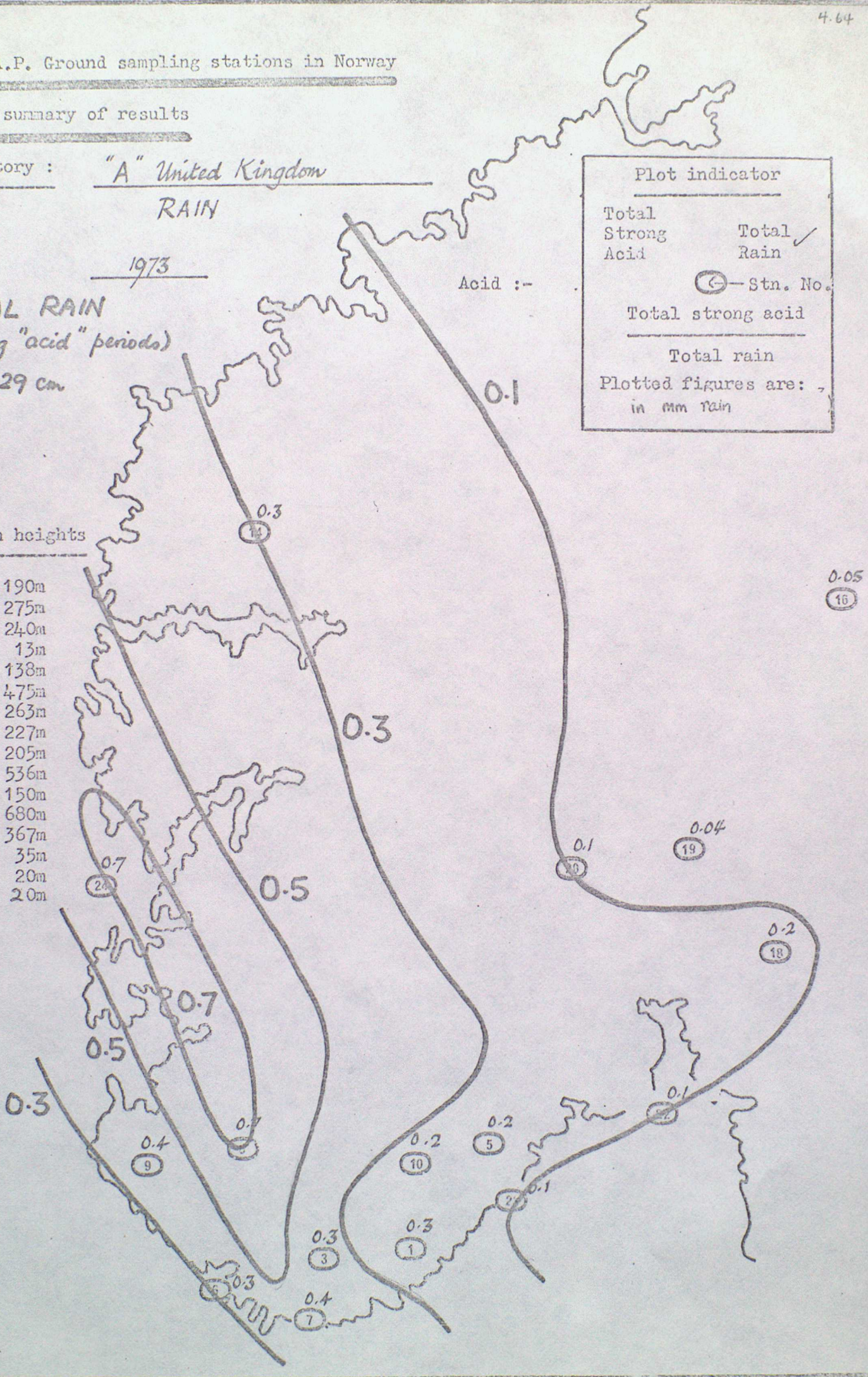
(6) — Stn. No.

Total strong acid

Total rain

Plotted figures are: in mm rain

Acid :-



L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : "B" Holland and W. Germany

Year : 1973

TOTAL STRONG ACID
(during "acid" periods)
Av. = 10

Plot indicator

Total Strong Acid — Total Rain

Stn. No.

Total strong acid

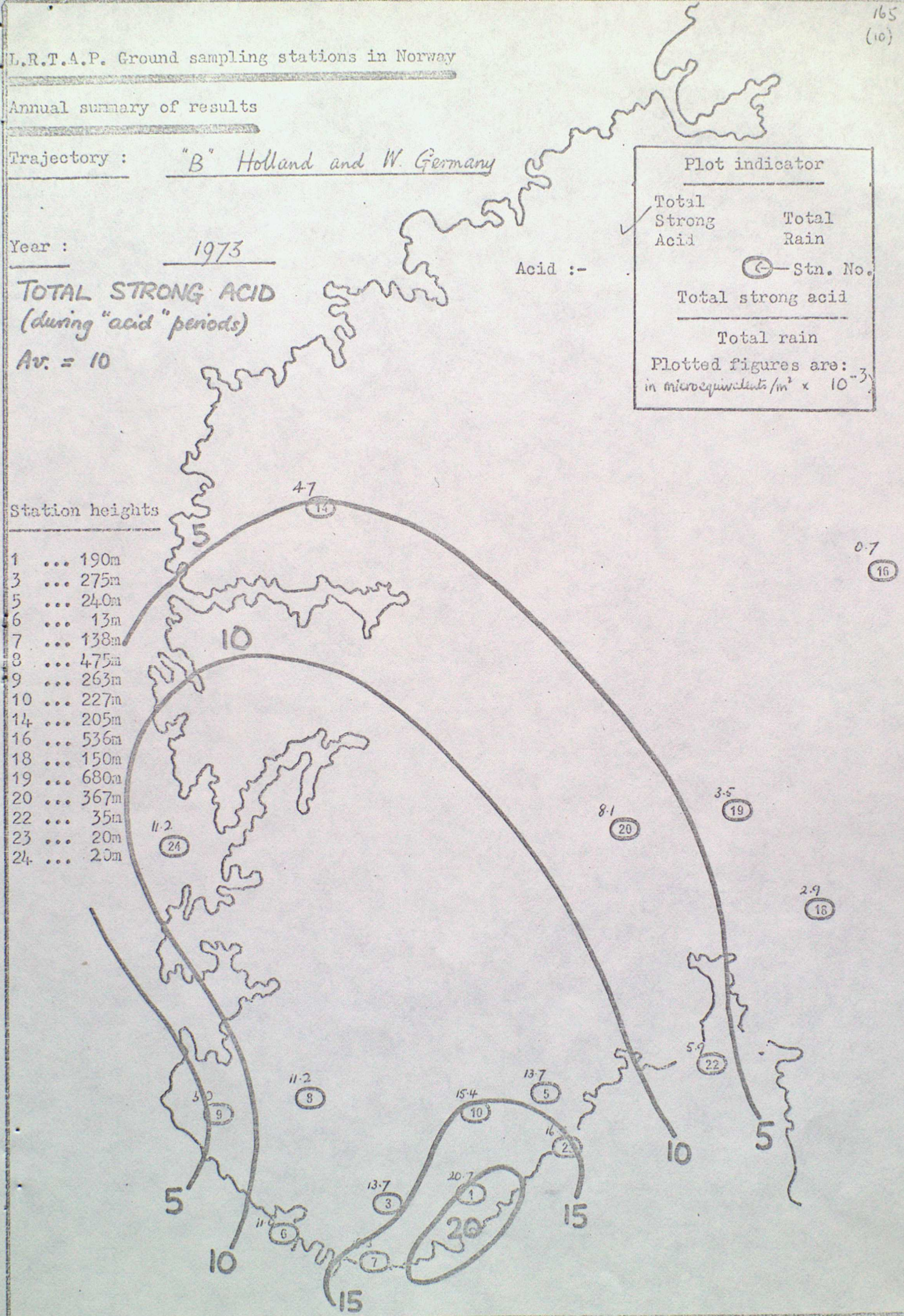
Total rain

Plotted figures are: in microequivalents/m^2 x 10^{-3}

Acid :-

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m



(1115)
280
70

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'B' HOLLAND AND RHUR.

Year : 1973

ACID CONC.
(during "acid" periods)
$\bar{C}$ = 70

Plot indicator

Total Strong Acid — Total Rain

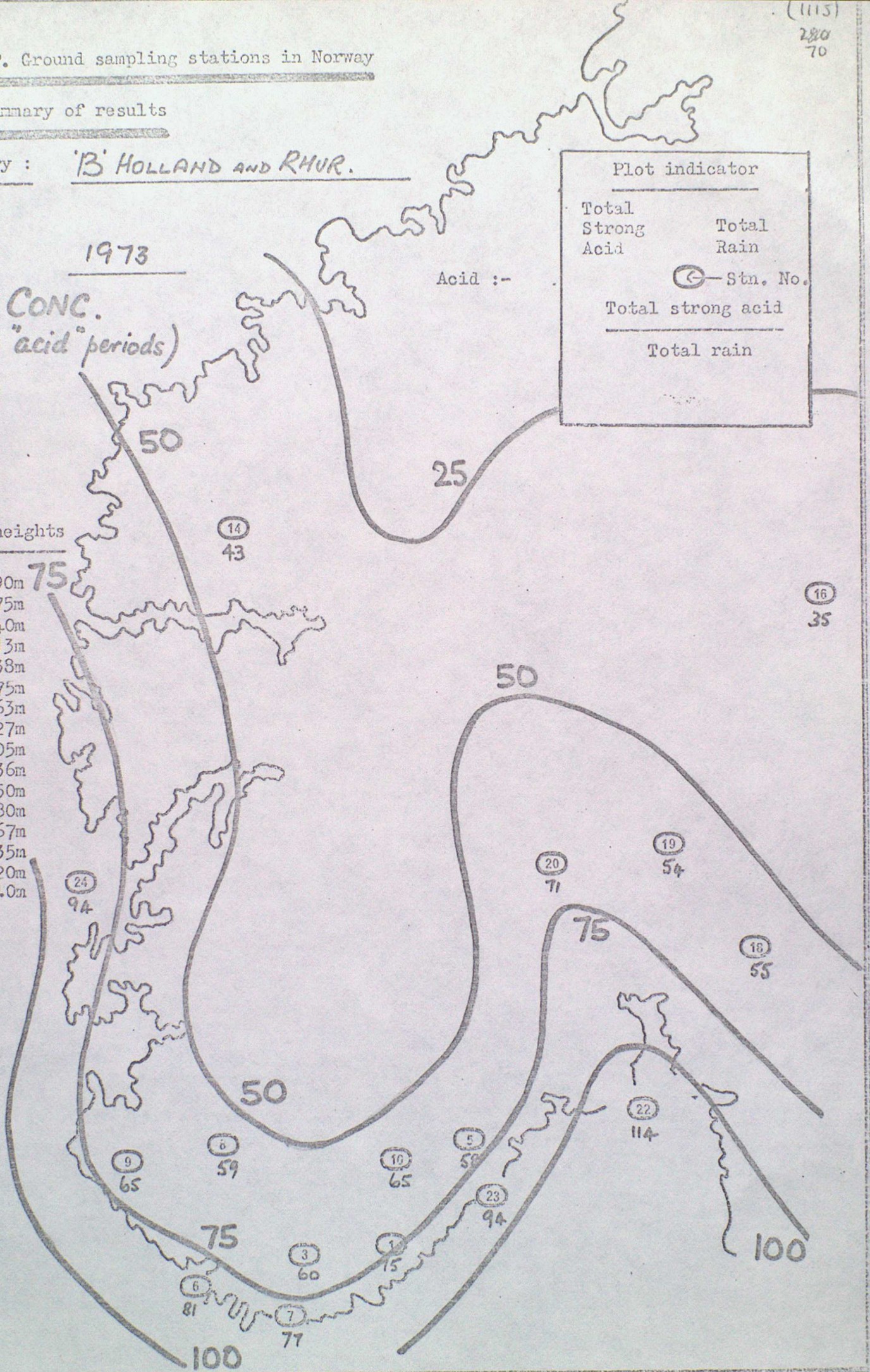
Stn. No.

Total strong acid / Total rain

Acid :-

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m



(2200)
138

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'B' HOLLAND AND RHUR.

Year : 1973.

TOTAL RAIN
(during "acid" periods)
$\bar{r}$ = 13.8 cm.

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m

Plot indicator

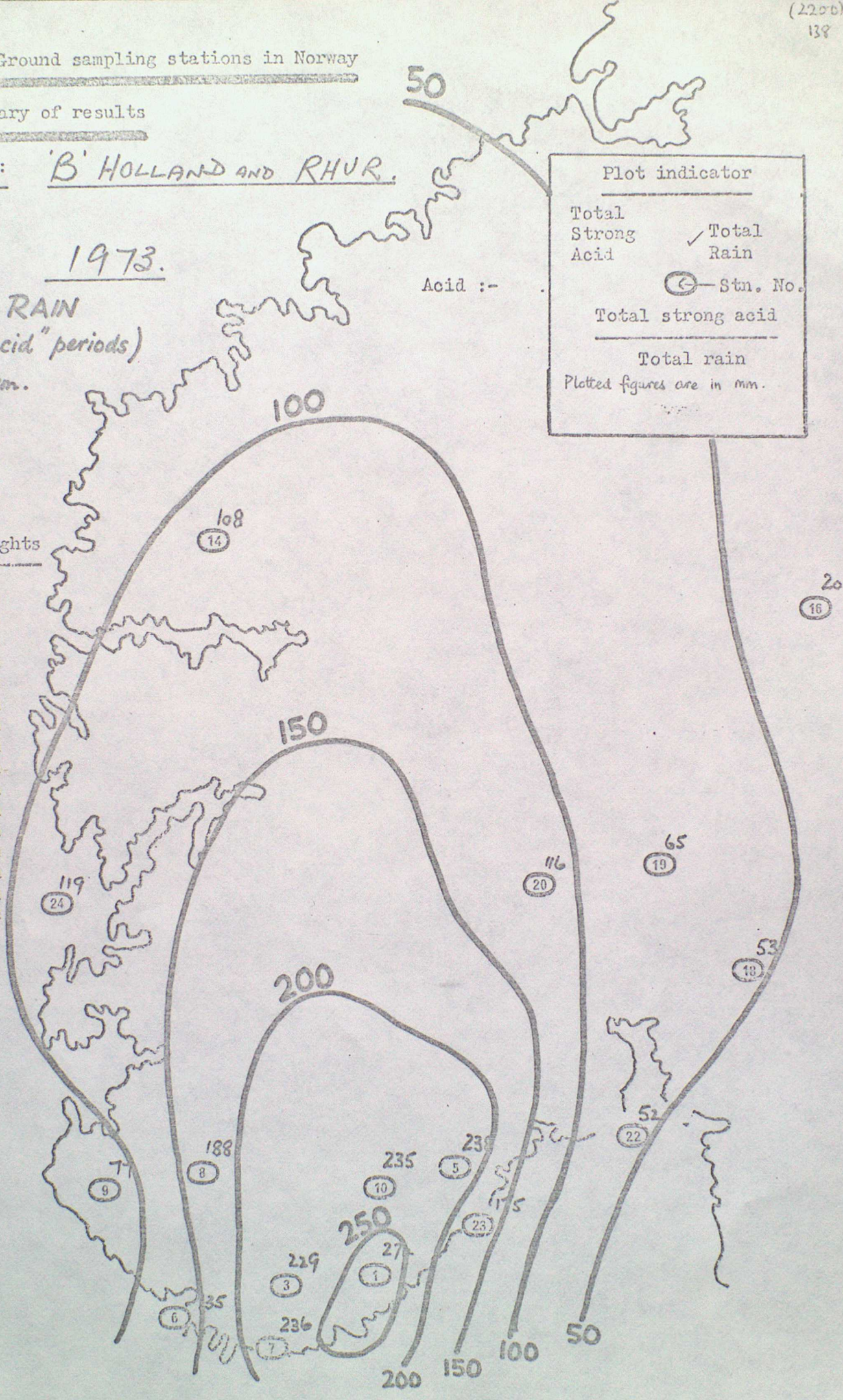
Total Strong Acid ✓ Total Rain

(c)—Stn. No.

Total strong acid

Total rain

Plotted figures are in mm.



L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : "C" E. Germany & Poland

Year : 1973

TOTAL STRONG ACID
(during "acid" periods)
Av. = 4.1

Acid :-

Plot indicator

Total Strong Acid — Total Rain

Stn. No.

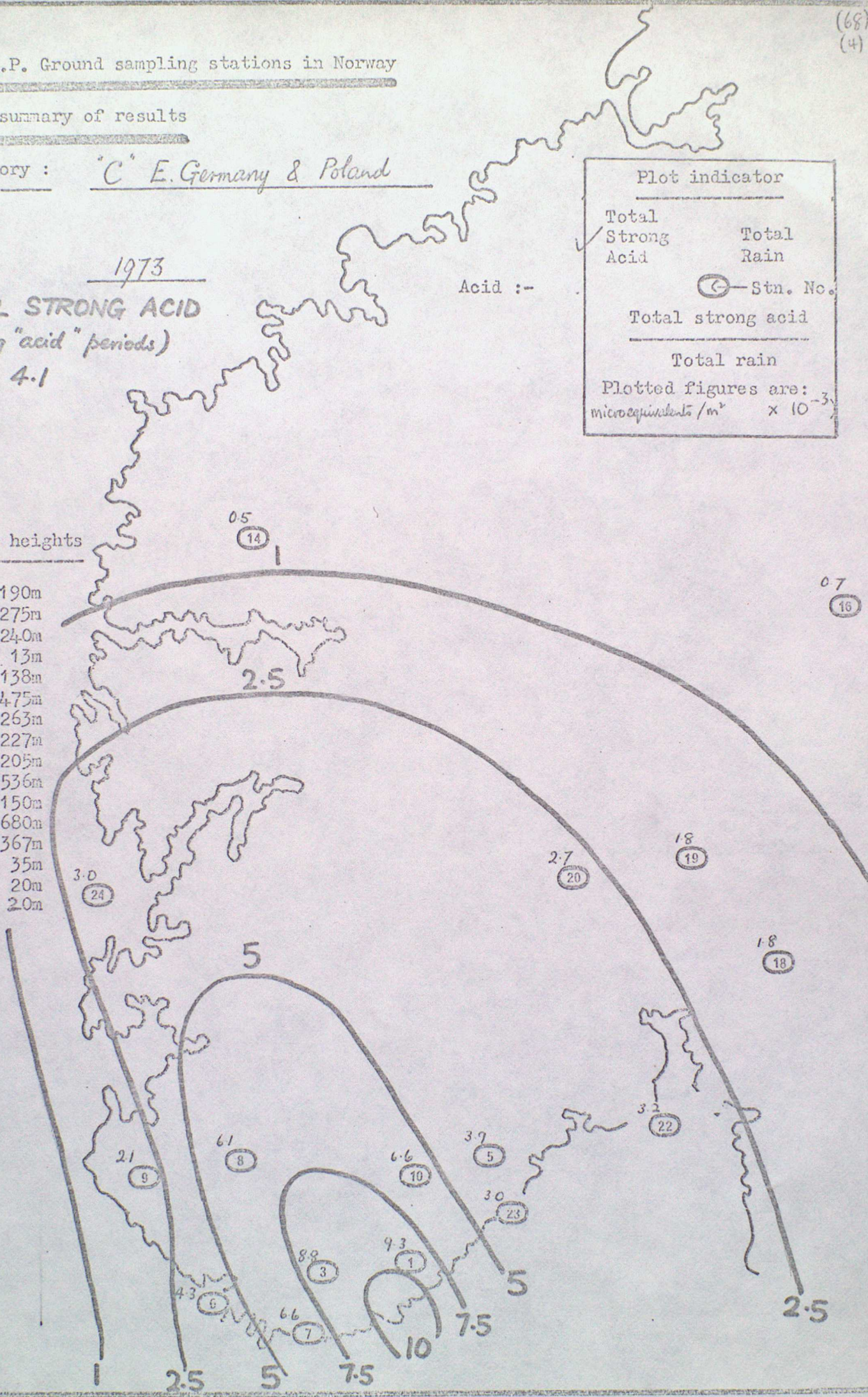
Total strong acid

Total rain

Plotted figures are: microequivalents/m² × 10^{-3}

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m



$\bar{C} = 42.4$

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : C'E. GERMANY AND POLAND.

Year : 1973

CONC. ACID
(during "acid" periods)
$\bar{C} = 42.4$

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m

Plot indicator

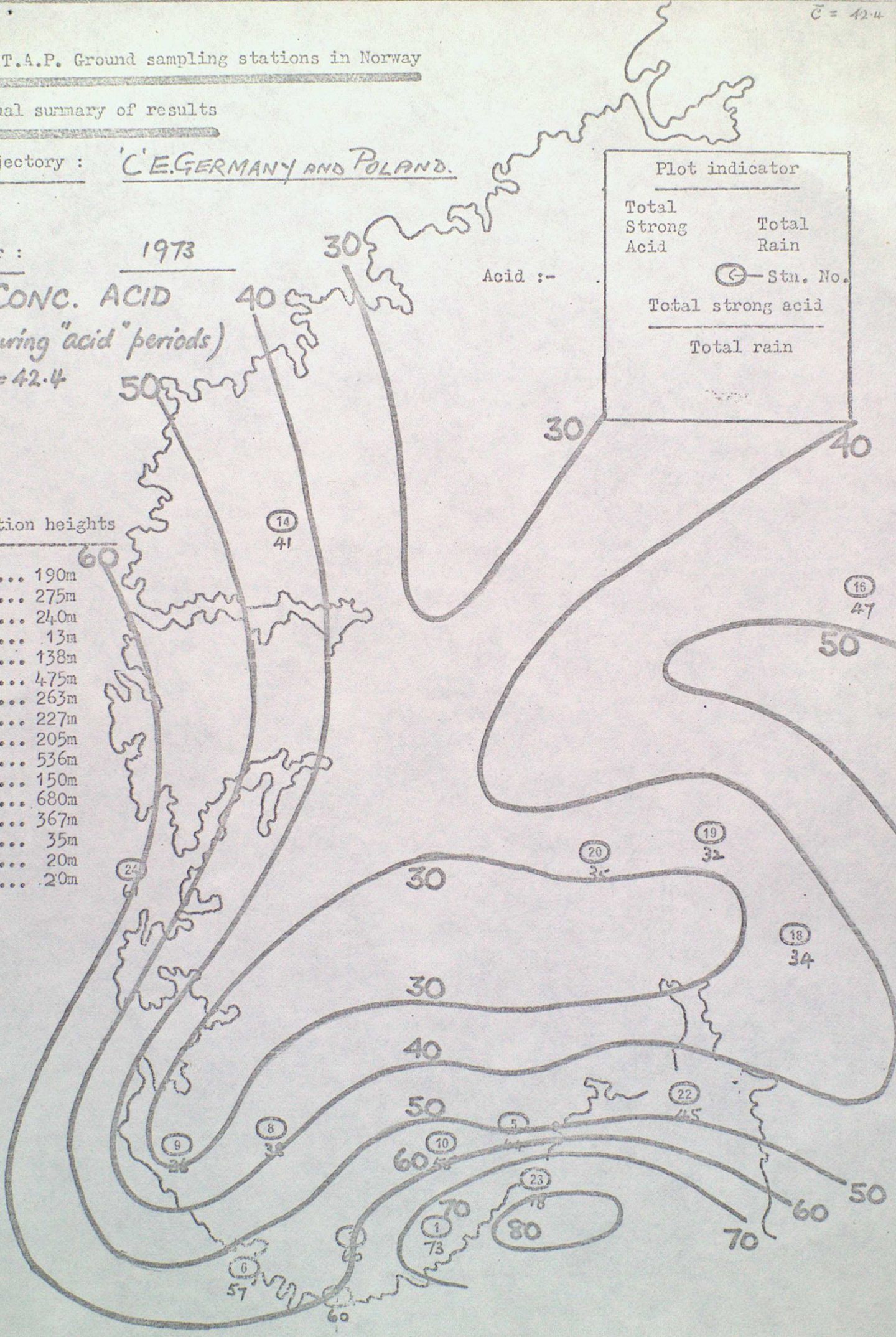
Total Strong Acid — Total Rain

Stn. No.

Total strong acid

Total rain

Acid :-



L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'C' E. GERMANY AND POLAND.

Year : 1973

TOTAL RAIN
(during "acid" periods)
$\bar{r}$ = 9.4 cm.

Acid :-

Plot indicator

Total Strong Acid

✓ Total Rain

Stn. No.

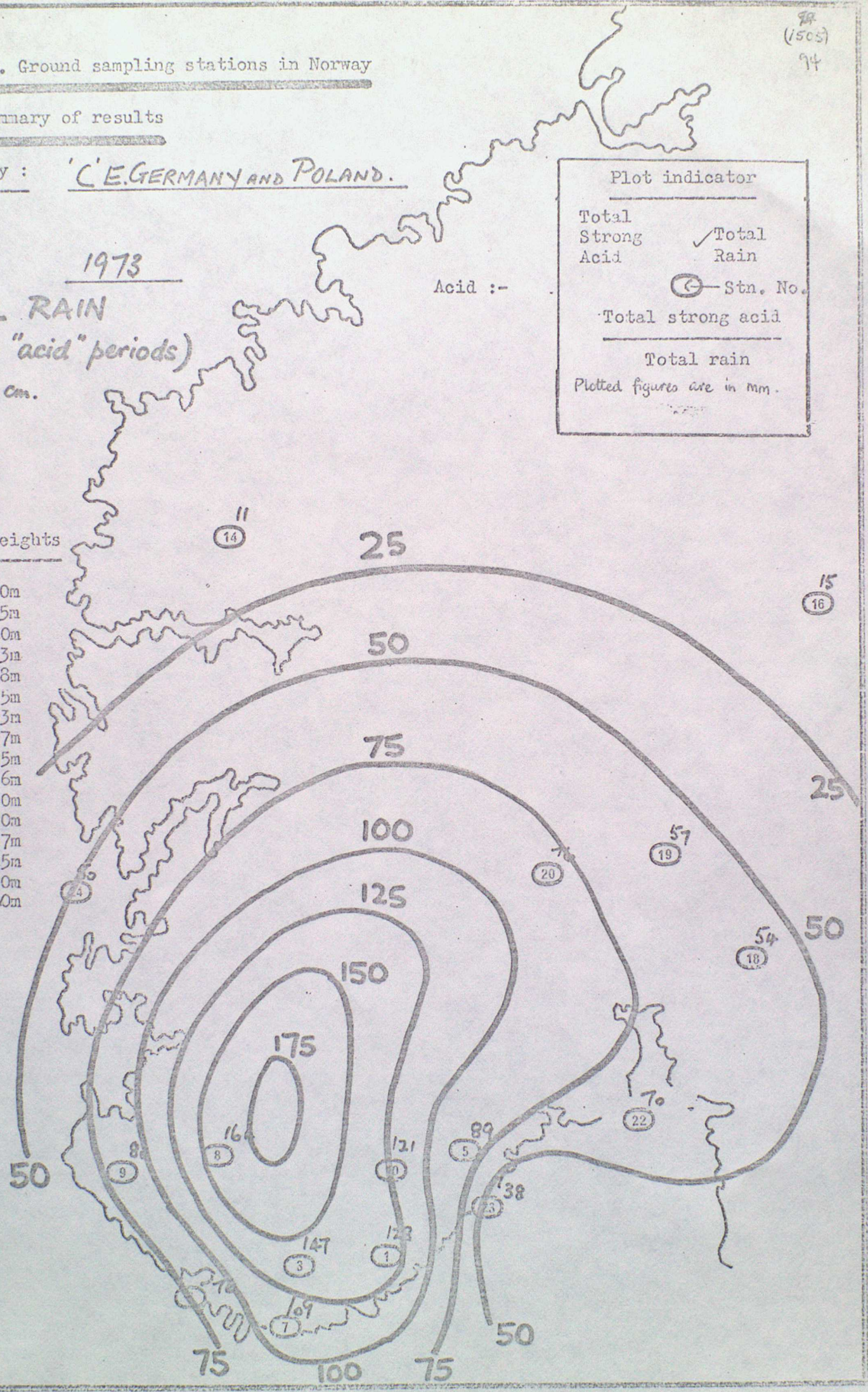
Total strong acid

Total rain

Plotted figures are in mm.

Station heights

1 ... 190m
3 ... 275m
5 ... 240m
6 ... 13m
7 ... 138m
8 ... 475m
9 ... 263m
10 ... 227m
14 ... 205m
16 ... 536m
18 ... 150m
19 ... 680m
20 ... 367m
22 ... 35m
23 ... 20m
24 ... 20m



(102)
6

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : "D" OCEANIC

Year : 1973

TOTAL STRONG ACID
(during "acid" periods)
Av. = 6

Acid :-

Plot indicator

Total Strong Acid ✓ Total Rain

Stn. No.

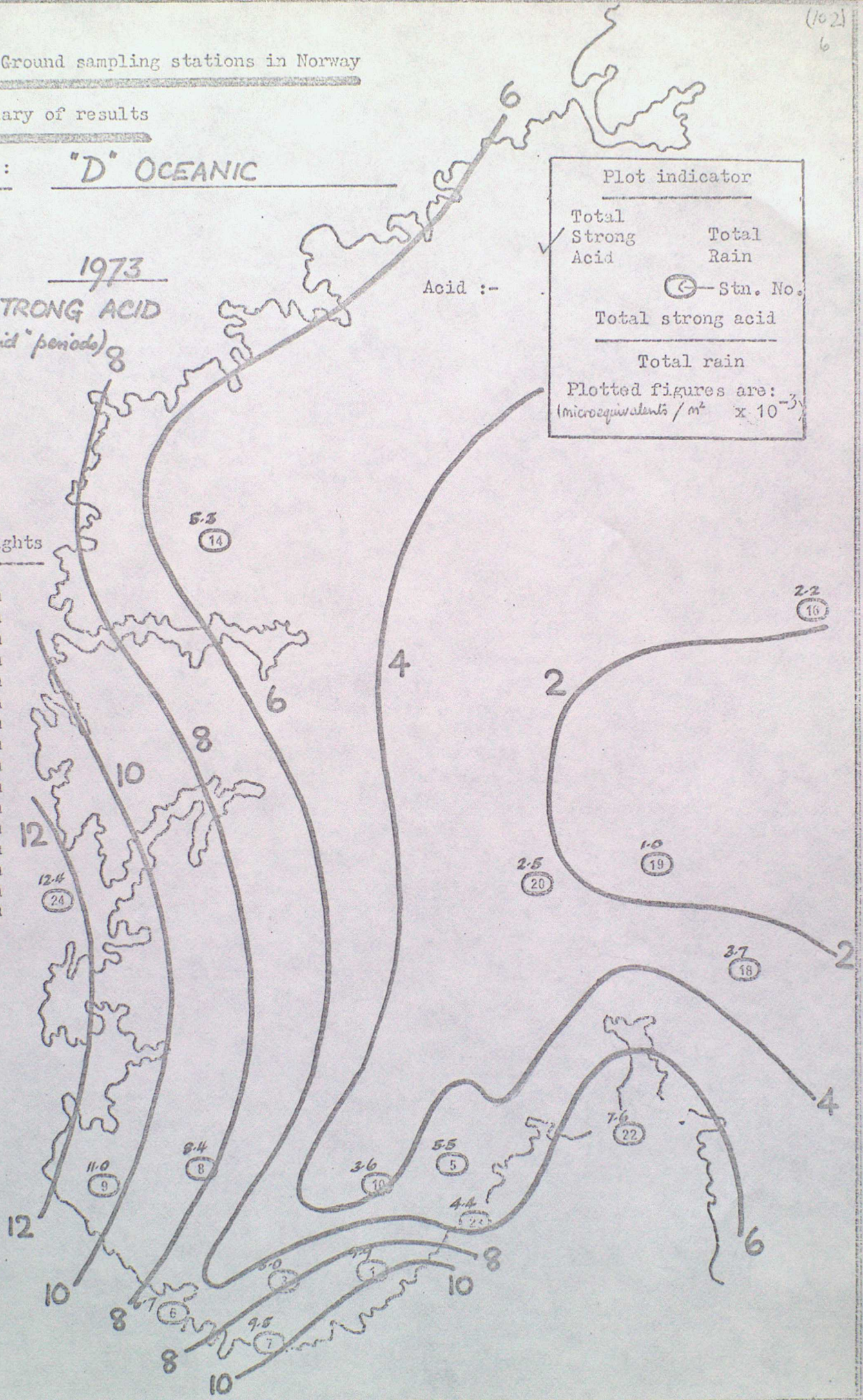
Total strong acid

Total rain

Plotted figures are: (microequivalents / m^2 x 10^{-3})

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	2.0m



L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'D' OCEANIC.

Year : 1973

CONC. STRONG ACID
(during "acid" periods)
$\bar{C}$ = 26

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	2.0m

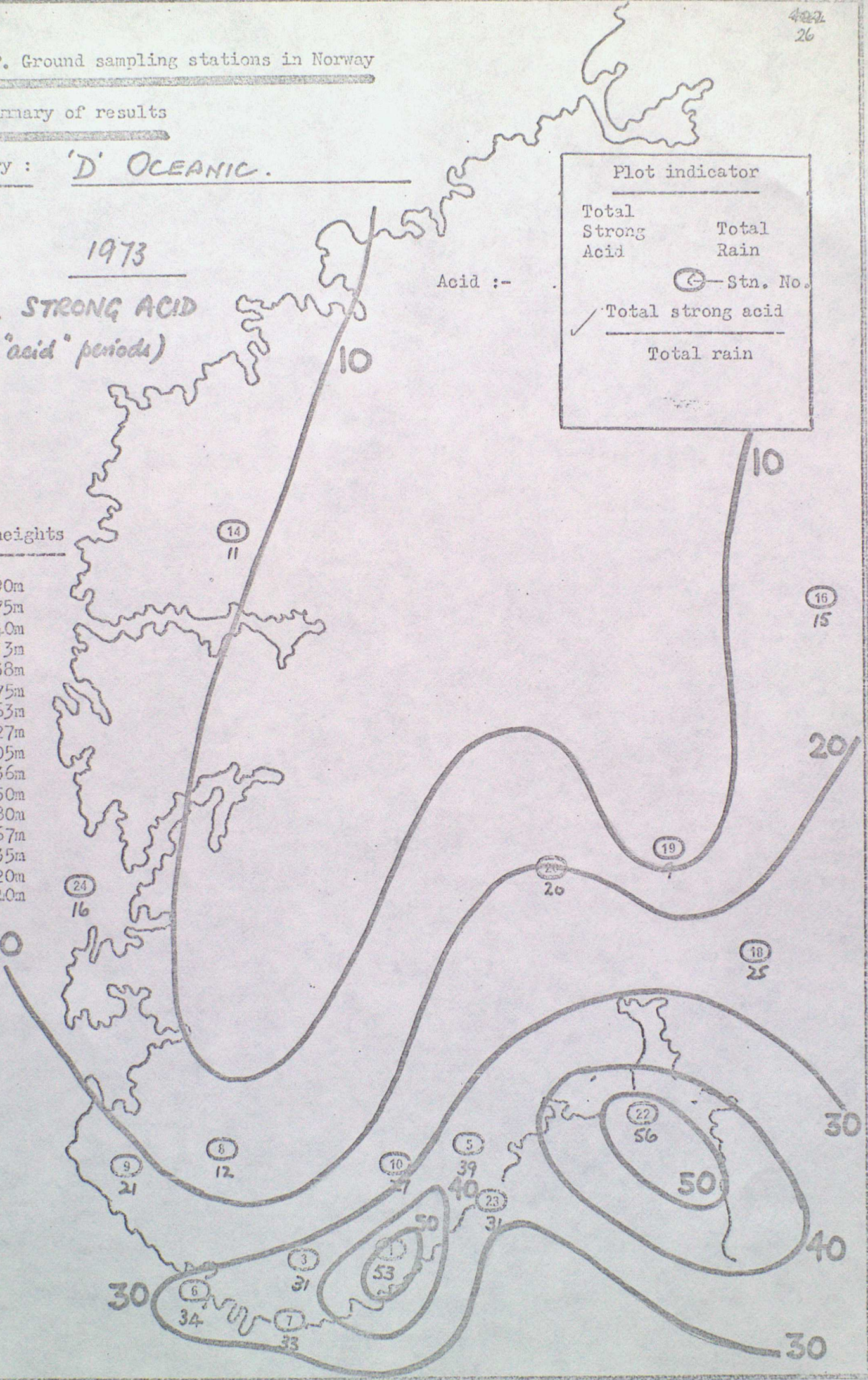
Plot indicator

Total Strong Acid / Total Rain

Stn. No.

Total strong acid / Total rain

Acid :-



L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'D' OCEANIC.

Year : 1973.

RAIN (in "acid" periods)

$\bar{r}$ = 38.3 cm

Acid :-

Plot indicator

Total Strong Acid ✓ Total Rain

Stn. No.

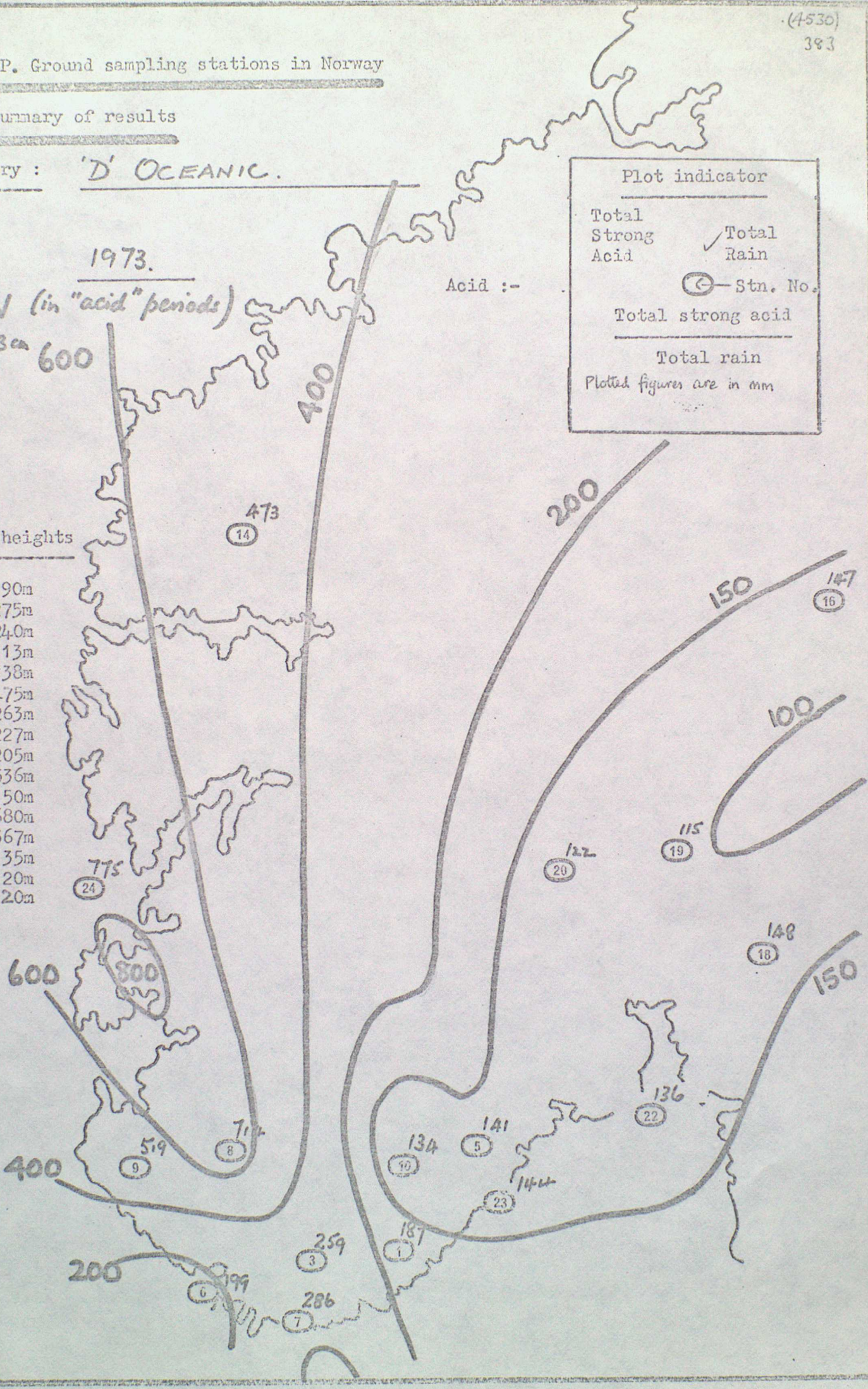
Total strong acid

Total rain

Plotted figures are in mm

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m



L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : "E" East & North East Trajectories

Year : 1973

TOTAL STRONG ACID
(during "acid" periods)
Av. = 2.0

Plot indicator

Total Strong Acid — Total Rain

Stn. No.

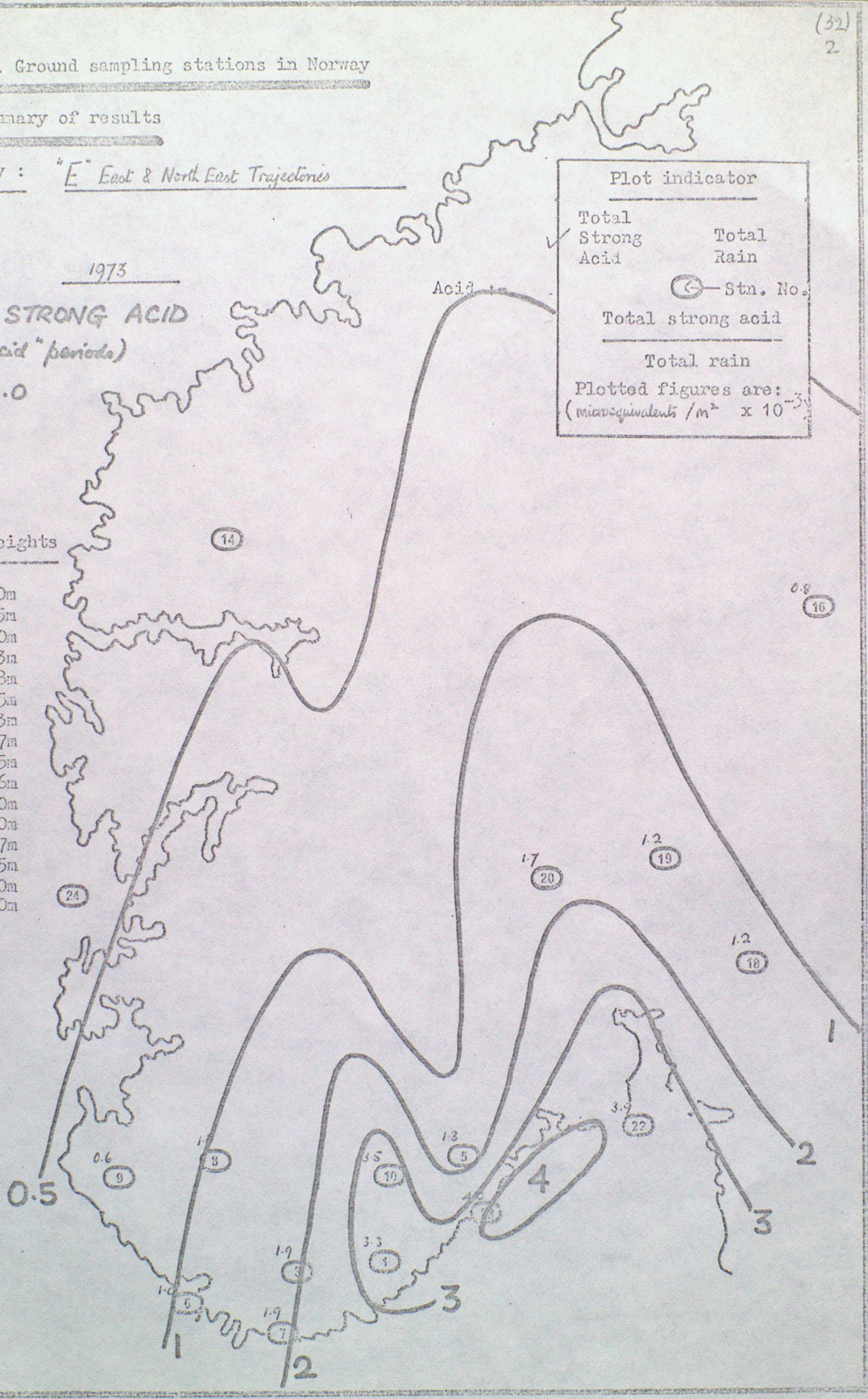
Total strong acid

Total rain

Plotted figures are: (microequivalents /m² x 10^{-3})

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m



(1255)
76

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'E' EAST AND NORTH EAST TRAJECTORIES

Year : 1973

TOTAL RAIN
(during "acid" periods)
$\bar{r}$ = 7.6 cm

Acid :-

Plot indicator

Total Strong Acid ✓ Total Rain

Stn. No.

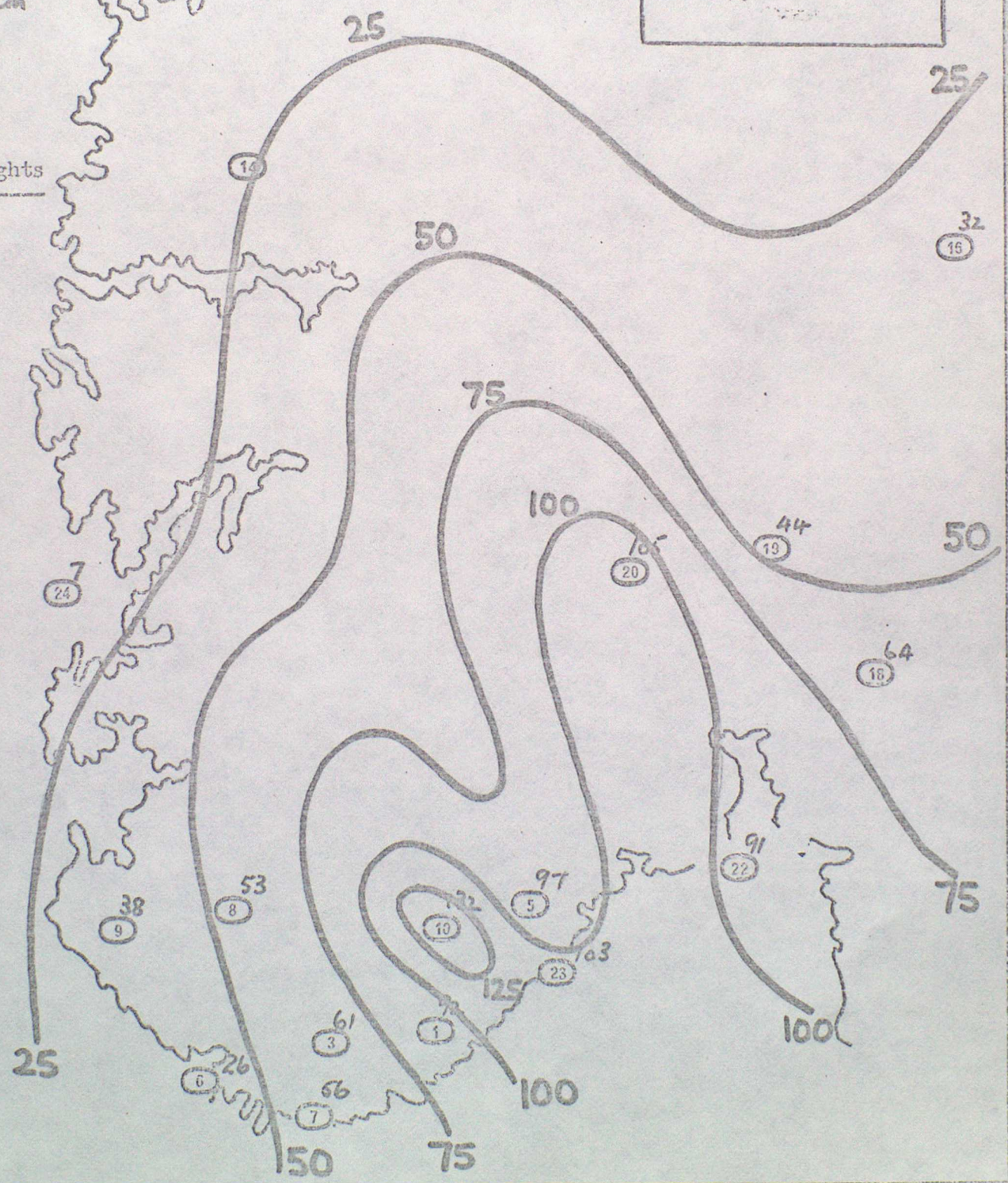
Total strong acid

Total rain

Plotted figures are in mm.

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	20m



$\bar{C} = 23.1$

L.R.T.A.P. Ground sampling stations in Norway

Annual summary of results

Trajectory : 'E' EAST AND NORTHEAST TRAJECTORIES.

Year : 1973.

Conc. Strong Acid (during "acid" periods)

$\bar{C} = 23.1$

Plot indicator

Total Strong Acid / Total Rain

Stn. No.

Total strong acid

Total rain

Acid :-

Station heights

1	...	190m
3	...	275m
5	...	240m
6	...	13m
7	...	138m
8	...	475m
9	...	263m
10	...	227m
14	...	205m
16	...	536m
18	...	150m
19	...	680m
20	...	367m
22	...	35m
23	...	20m
24	...	2.0m