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INCIDENCES FROM MODIFICATIONS OF
THE COMPUTATIONAL METHODS OF THE
PSOPHIC INDEX

Jacques Francois

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16. Abstract

In France, the level of annoyance in areas around airports is represented by the psophic index N.

Various modifications have recently been proposed in the method of calculating this index in order to improve the index as an annoyance indicator.

This document has the purpose of discussing the quality of the modified N index as a prognostic index for annoyance caused by aircraft noise.

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# INCIDENCES

# FOR MODIFICATION OF COMPUTATIONAL METHODS

## OF THE PSOPHIC INDEX

Jacques Francois

## TABLE OF CONTENTS

The level of annoyance in areas around airports is represented by the psophic index N in France. This index has been developed by services of the SGAC and allows one to plot isopsophic curves, which are used as a basis for certain regulamentary measures for urban control around airports.

Various modifications have recently been proposed in the method of calculating this index in order to improve the index as an annoyance indicator. Certain weightings have been modified, and certain particular effects have been taken into account.

The present document has the purpose of discussing the quality of the modified N index as a prognostic index for annoyance caused by aircraft noise.

In the following pages we will do the following:

1. Summary of the methodology and development of an an annoyance indicator.

2. Modifications of the method of calculation of noise exposure.

3. Incidence of these modifications and their effect on forecasting annoyance.

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*Numbers in right margin represent pagination of foreign text.

## I.   SUMMARY OF METHODOLOGY AND DEVELOPMENT OF AN ANNOYANCE INDICATOR

Before adapting the psophic index N as an indicator of annoyance for noise around airports, it is important to know its validity and significance.  One would have to answer the following questions:

-- Does the annoyance level vary as a function of the values of the index N?

-- What is the form of the relationship between these two variables?

-- What is the intensity of annoyance sensed by persons living around airports at a location characterized by a given value N?

At the request of the STNA, the IFOP (French Public Opinion Institute) researched the areas around airports in order to respond to these questions and to give a constructive criticism of the exposure index N.

The Orly Airport was used for this study.  In the vicinity of this airport, the annoyance is greatest due to intensity (heavy aerial traffic) and because of the numerical size of the population under consideration.  As an inquiry zone, we defined an extensive zone (about 110 km$^2$) so that large variations of exposure to noise and annoyance would occur.  It is shown in the map given in the Appendix (see page 22).

The purpose of the study was to analyze the relationship between the noise and the annoyance globally, at the level of the entire  zone defined.  Also, on a more detailed scale, we wished to examine the local variations of these variables. This

large zone was cut up into squares of reduced dimensions, so that one could consider that the exposure conditions to noise were homogeneous within each square. The sector studied was divided up on the basis of nine squares per square kilometer (i.e., a square with a side length of 333 m).

It was necessary to measure the annoyance level in each square having a side length of 1/3 km.

Previous studies showed that the annoyance sensation caused by aircraft noise often varied strongly from one individual to another, with the same noise exposure. To the extent where one wished to analyze the correlation and the variations of the annoyance and the noise in a precise and local manner, it was sufficient to know the annoyance for a single individual in each square. Therefore, it was necessary to define average annoyance levels at each point of a territory.

Therefore, we were led to performing five interviews per square having a side length of 333 m, i.e., 45 interviews per $Km^2$. Overall, 5,000 persons were interrogated. The distribution of interviews was carried out in a uniform manner within the zone under study[1]: given the objective of the study, it was not useful to distribute the sample in proportion to the real density of population.

The questionnaire given to each person interrogated included a number of questions about annoyance caused by aircraft noise, its intensity, its frequency and its manifestations. In order to synthesize the responses of each person interviewed and to position them on an annoyance scale, we carried out factorial analysis.

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[1]Interviews were not performed in squares where fewer than five persons resided.

It is known that factorial analysis allows one to iso-
late the various factors that take into account the variance of
the results. In other words, it demonstrates the sub-dimensions
as a function of which the responses to the questions are organ-
ized. Therefore, we can summarize the information collected from
individuals by studying not only the collection of his responses
to the various questions, but by measuring his position along the
axes or with respect to factors which could constitute latent
variables of some type.

This treatment of the information is particularly well
suited to the objective in mind, because it allows one to deter-
mine the weighting coefficients of each question and to calculate the
"note" obtained by each individual for the various significant
factors which were isolated.

Since it is known a priori that the questions to which
the factorial analysis corresponds all allow the expression of
the annoyance to varying degrees, we were assured that the main
factor of this analysis would translate the intensity of the
perceived annoyance. A simple transformation then allowed us
to construct an annoyance index from this factor.

Examination of this annoyance index (which we will call
GO) leads us to formulate the following conclusions[1]:

- Validity: GO measures the intensity of annoyance by
   synthesizing its various aspects.

- Sensitivity: The sensitivity of GO varies according
   to the level of the index. Practically speaking, we
   can assign a significance to a variation of one point

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[1]The establishment of the index and its critical analysis in detail were pre-
   sented in the report "Relationship between Noise and Annoyance around Orly
   Airport" (January, 1973).

in weak and medium zones, and two points in high annoyance zones.

- Calibration: Interpretation of the values of GO shows that we can schematically distinguish six large levels of annoyance:

  - Zero annoyance. . . . . . . .GO less than 40
  - Weak annoyance. . . . . . . .GO between 40 and 55
  - Rather strong annoyance . . .GO between 55 and 65
  - Strong annoyance. . . . . . .GO between 65 and 70
  - Very strong annoyance . . . .GO between 70 and 90
  - Intolerable annoyance . . . .GO greater than 90

We calculated the annoyance note for each of the 5,000 persons interviewed. We then established the average value of the index GO in each square with a side length of 1/3 km (i.e., the average of the five individual notes). These average notes were then related to the index of exposure to noise in the square. They also allowed us to draw a map of annoyance around the airport (see Appendices page 23).


II.  MODIFICATIONS OF CALCULATION METHOD AND THEIR INCIDENCE . /4
     FOR THE INDEX N.

The calculation programs of the index N from theoretical data have been modified substantially since 1971, the date of the inquiry carried out around Orly Airport[*]. Substantial differences resulted in the plotting of the isopsophic curves (see pages 29 and 30, which show the maps giving the isopsophic curves established before and after modification of the method of calculation).

Below, we will describe the modifications introduced and

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[*] The interviews were performed between April 8 and May 17, 1971.

we will discuss their influence on the psophic index in general, as well as pertaining to Orly Airport in particular.

1. <u>Nocturnal movements</u>.

In the old method we separately calculated a diurnal index and a nocturnal index, using different methods. These indices were not directly comparable, and it was also not possible to accumulate them directly in order to obtain a global representation of noise exposure.

Diurnal exposure zones were determined around an airport, as well as nocturnal exposure zones assumed to correspond to the former. Finally, we only retained the most severe exposure (the most extensive zone).

Practically speaking, this led to night exposure not being given any consideration at all for most airports. In effect, it was necessary for nocturnal traffic to be on the order of 15% of total traffic in order to become predominant.

In contrast to the old method, the psophic index is henceforth a number that represents the total noise exposure, both diurnal and nocturnal. Each nocturnal movement is considered to be equivalent to ten identical diurnal movements.

The new formula is, in effect, the following:

$$N = 10 \log \left( \sum_{i=1}^{n} 10^{\frac{Ni}{10}} + 10 \sum_{i=1}^{p} 10^{\frac{Ni}{10}} \right) - 32$$

Formula 1.

N = Psophic index at the considered point

N1 = Noise level at the point considered of an individual movement expressed in dB N

n = Number of diurnal movements of a typical day (day = 6 to 22 hours).

p = Number of nocturnal movements of a typical day (night = 22 to 6 hours)

The typical day is the average annual day.

This modification is fundamental, but it has practically /5 no influence in the case of Orly Airport, because noisy aircraft (jet aircraft) are not allowed at night. The slight traffic that is authorized at night (postal aircraft) is obviously taken into account but does not substantially modify the values of the index calculated according to the old method, because the additive constant -32 was selected in part because of this effect, by replacing the constant -30 of the old diurnal calculation.

2. <u>Ground effect and masking effect.</u>

When the acoustic ray incidence on the ground is weak, the noise is subjected to an additional attenuation, in addition to the attenuation caused by distance. The ground absorbs part of the acoustic waves. This phenomenon, which is called the ground effect, was not taken into account in the evaluation of the noise levels used to calculate the psophic index.

This ground effect is essentially a function of the lateral distance from the point under consideration to the trajectory of the aircraft. It also depends on the acoustic spectrum

of the noise at the source and the incidence angle β of the acoustic ray with respect to the ground.

In the empirical formulation used to translate this phenomenon, the effect is maximum for grazing incidence (β = 0 degree); it decreases when the incidence increases and becomes zero for β > 30 degrees.

In order to take the acoustic spectrum into account, two laws were defined, one for the approach and one for take-off.

In order to give an idea of the importance of this phenomenon, we can mention a few numbers for grazing incidence: for lateral distances of 120, 300 and 1200 meters, the attenuation of the noise due to ground effect is 2, 6 and 10 PNdB, respectively, for take-off and 2, 7 and 15 PNdB for landing.[1]

Also, when the incidence of the acoustic rays on the ground is small, we can realize that certain engines are masked by the aircraft airframe, and there is also a reduction in the noise with respect to noise estimated at large distances. This effect is called the masking effect.

The formulation used for translating the masking effect only involves the incidence angle β of the acoustic rays at the ground. The attenuation is 2 PNdB for grazing incidence (β = 0 degree), and is reduced when the incidence increases, and is zero for β = 30 degrees.

The introduction of the ground effect and masking effect into the program is translated by a localized reduction of the values of the psophic index. Therefore, a modification of the contour of the curves results (shrinking) in zones located trans-

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[1]Beyond 1200 meters, the attenuation is constant.

verse to the runways and in their immediate extensions (aircraft near the ground).

## 3. Dispersion of the trajectories.

The theoretical trajectories established for each airport are followed in a more or less precise manner by the pilot. In addition to human piloting factors, this remark also refers to the infrastructure. We can assume that the trajectories for approach are accurate, because the pilot has good visual references and precise radio-electrical aids. This is not true for take-off, because aircraft are going to various destinations, and the trajectories are very often not accurately followed.

For the calculation programs, trajectories are based on hypotheses that take into account various degrees of accuracy of the infrastructures utilized.

This is translated into a smaller concentration of the higher indices along the theoretical trajectories, especially for take-off. In other words, the "tongues" of the isopsophic curves are widened but shortened.

Taking into account the dispersion allows one to assign numbers to noise exposure with more realism in the vicinity of the theoretical trajectories.

## 4. Utilization of the coefficients of runway use.

The general formula [1] of the psophic index presented above, as well as the older formulations (see Appendix II of the report of January, 1973), is not directly usable except in a case where the airport has a single runway direction. Such a case is

almost never encountered, because a single runway results in two possible directions.

In practice, we calculate partial indices relative to one direction of the runway. For this we weight the number of motions of a typical day, n and p in formula [1], using the use frequency coefficient t of the runway direction. (t = ratio of the number of days in the year when the runway direction is used with respect to 365).

This amounts to adding the term + 10 log t to formula [1]. The total psophic index is obtained by "logarithmic summation" of the partial indices:

$$N\ Total\ =\ 10\ log\ \left( \sum 10^{\frac{N\ partial}{10}} \right)$$

Before, one used the term +10 log $\sqrt{t}$ = 5 log t. The noise exposure was therefore overestimated in a non-uniform manner: the overestimation was greater, the smaller the coefficient t.

The present method re-establishes the logical use of the term 10 log t, which has non-negligible consequences for the values of the psophic index in the inquiry zones around Orly Airport.

The runway frequency coefficients at Orly Airport are essentially the following: t = 0.7 for configurations going to the west, t = 0.2 to the east and t close to 0.05 to the north and south.

The indices for trajectories going west were therefore overestimated by 0.7 points. Those for trajectories going east were overestimated 3.5 points, and those for trajectories going north and south were overestimated by 6 to 7 points.

10

In the southern zone of the inquiry, all of the indices were reduced by 6 to 7 points, but in the western zone, essentially exposed to take-offs going to the west, we believe that they remain stable. This is also true in the northeast zone, exposed to approaches to the west. On the other hand, in the southeast zone, they were reduced by 3.5 points.

## III.  OCCURRENCE OF MODIFICATIONS TO ANNOYANCE FORECASTING.

The modifications introduced in the calculation of the psophic index were intended to improve this index, i.e., to allow it to better predict the annoyance sensed by persons living around airports.

In the following, we will discuss the extent to which these modifications had the desired effect. Then we will examine the significance of the values of the psophic index in terms of annoyance.

## A.  IMPROVEMENT OF ANNOYANCE FORECASTING

We can assume that the new calculation method has tightened the relationship between the psophic index and the' annoyance. For the overall inquiry zone, the correlation coefficients[1] obtained are the following:

    -- old method:   r = .60
    -- new method:   r = .69

Let us recall that we found a coefficient of .56 with an index N calculated using the old method on the basis of traffic

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[1] The coefficients were calculated using the formula of BRAVAIS-PEARSON by taking as the statistical units the average notes of GO relative to each group of persons interviewed located in the same square with a side length of 1/3 km and the value of the index N calculated at the center of each of these squares.

predictions. (See the report "Relationship between the Noise and Annoyance Around Orly Airport", March, 1974). The analyses presented in the preceding reports take into account the isopsophic index calculated from traffic predictions for 1971. It was believed to be more realistic to re-evaluate the results by establishing an index corresponding to the traffic during the year the inquiry was made.

The new method allowed an improvement of nine points in the global correlation, which represents substantial progress. At the levels of the various sectors within the inquiry zone that were isolated (see map, page 31) we find that this improvement is systematic, but that it is higher along the east-west runway axis than in the north-south runway axis. Also, as before, the correlation is best in the eastern sector, and worst to the west and in the north-south axis.

| | | Old Method | New Method |
|---|---|---|---|
| Entire inquiry zone . . . . . . . . . . . . . . . | | .60 | .69 |
| Sectors: | | | |
| 1. | North-East . . . . . . . . . . . | .60 | .65 |
| 2. | East . . . . . . . . . . . . . . | .69 | .76 |
| 3. | West . . . . . . . . . . . . . . | .50 | .57 |
| 1+2+3. | East-West . . . . . . . . . . . | .64 | .71 |
| 4. | North-South . . . . . . . . . . | .57 | .60 |

Below, we will analyze the significance of the various /9 phenomena.

1. Systematic improvement of the correlation by sector.

In each sector of the inquiry zone, the correlation between the psophic index and the annoyance changed in the positive sense. We can see here in principle the results of taking into account trajectory dispersion.

12

The improvement of the correlation was especially notable along the east-west runway axis. It is less pronounced along the north-south runway axis.

In effect, the traffic for this runway consists essentially of approaches (flights with take-offs going east) for which the trajectory dispersion is minimal. It therefore seems normal that the improvement of the correlation in this sector, resulting from the new method, will be smaller than that found in other sectors.

In addition, along the north-south axis, the correlation becomes essentially weaker. It is known that a correlation coefficient constitutes in a certain sense a test of the hypothesis for a regression line. The distribution of the averages of GO as a function of N (see Figure on page 16 ) clearly shows that the hypothesis of a regression line is much less applicable in the north-south sector than in the east-west sector.

We can conclude that the index N predicts annoyance in a less satisfactory manner in the north-south sector. More precisely, in this zone, it is for the large values of N (N $>$ 80) that the validity of this index should be questioned. On the other hand, when N is less than 80, the annoyance increases regularly as a function of the psophic index.

The figure on page 17 illustrates this phenomenon: in contrast to what is observed for the east-west runway, the frequency of the responses expressing strong annoyance ("the annoyance disturbs me greatly", "the noise annoys me very often") ceases to increase along the north-south axis above N = 80.

We should note in a systematic manner that the persons living along the north-south runway sense a reduced annoyance for equal index N compared with inhabitants along the east-west

runway extension.

This type of phenomenon was demonstrated earlier in the preceding report, and we will use the same explanation hypothesis. The north-south runway is the secondary runway which handles only a small percentage of the movements of the airport. Along this runway the traffic occurs episodically. Short traffic periods of 15 days or 3 weeks occur between long periods of silence. This characteristic of the traffic could explain the lesser validity of the psophic index in this sector. In localities which have a higher index, the inhabitants would be better able to tolerate very noisy traffic days than they could a less noisy daily noise level.

## 2. Improvement of the global correlation coefficent.

The correlation coefficient calculated for the entire inquiry zone was improved substantially by the modifications made to the calculation methods for the psophic index.

In the old method, the indices of the north-south sector were greatly overestimated because of the use of the utilization coefficients of runways. The introduction of the term 10 log 5 in the formula for N allowed an increase in the coherence of ' the prediction of disturbance along the east-west axis and along the north-south axis.

Examination of the regression lines of GO and N allows us to substantiate this result. (See figure on pages 18 and 19). For the index N calculated with the old method, the slopes of the regression lines for the east-west axis and for the north-south axis were very different.

By using the modified N index, the regression line of the east-west axis was given a translation, but its slope remained

essentially the same. On the other hand, the slope of the line
for the north-south sector became greater, and therefore came
closer to the line for the east-west sector. In other words,
in the GO-N diagram, the "cloud of points" of the east-west
sectors and north-south sectors are now practically overlapping.
Therefore, there is an accentuation of the slope of the global
regression line.

A single line, therefore, allows one to summarize the
entire collection of points, and better than when the old method
was used. This is the mathematical significance of an increase
in the correlation coefficient.

B.  SIGNIFICANCE OF THE PSOPHIC  INDEX IN TERMS OF ANNOYANCE       /15

The new calculation method of the  psophic  index led to
an accentuation of the slope of the regression line of GO with
respect to N, which resulted in both a translation of the regres-
sion line of the east-west sector and an increase in the slope of
the line for the north-south sector.

Therefore, a given value of N no longer corresponds to
the same annoyance level as before.

With the new index, the isopsophic  curves have shrunken
overall, so that for the same value of N, the annoyance is now
stronger.

The interpretation of the significance in terms of
annoyance of the isopsophic  index presented in the previous
report must now be reviewed.

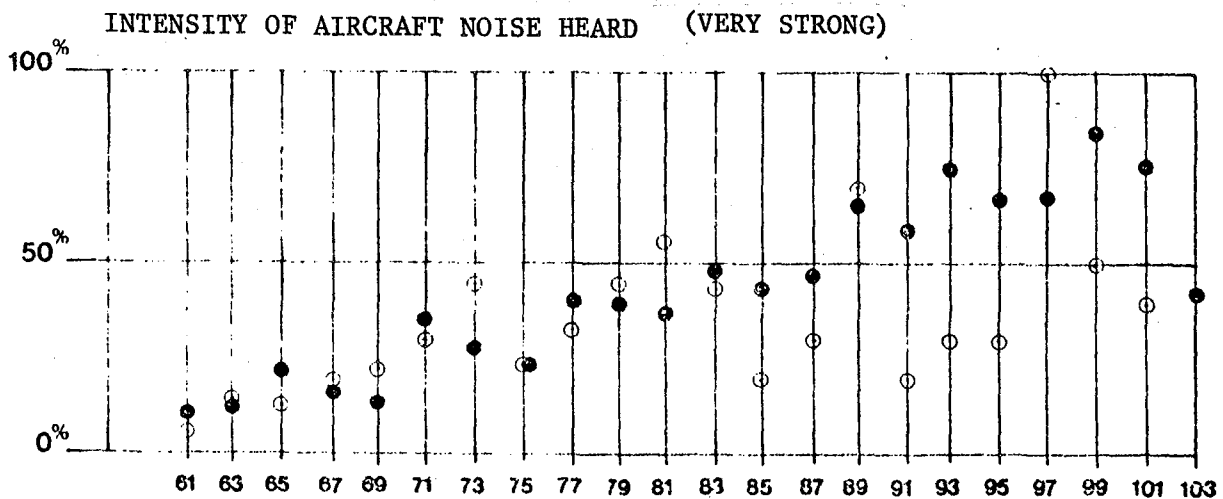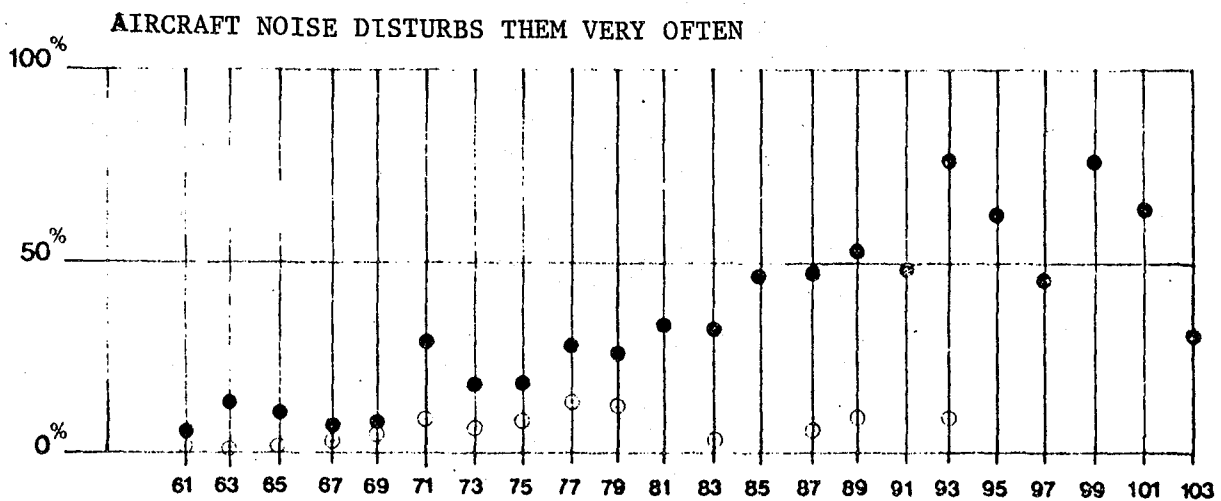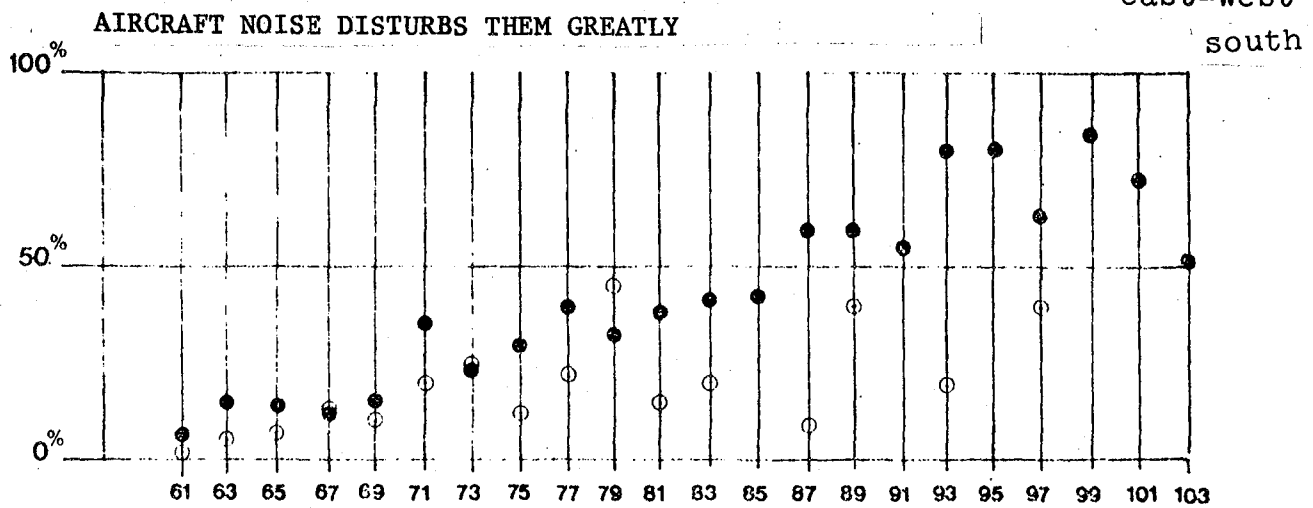In order to establish a "correspondence table" between

AVERAGE OF THE ANNOYANCE INDEX "GO" ACCORDING TO THE EXPOSURE
INDEX "N" (CALCULATED BY THE NEW METHOD)



* east-west sector
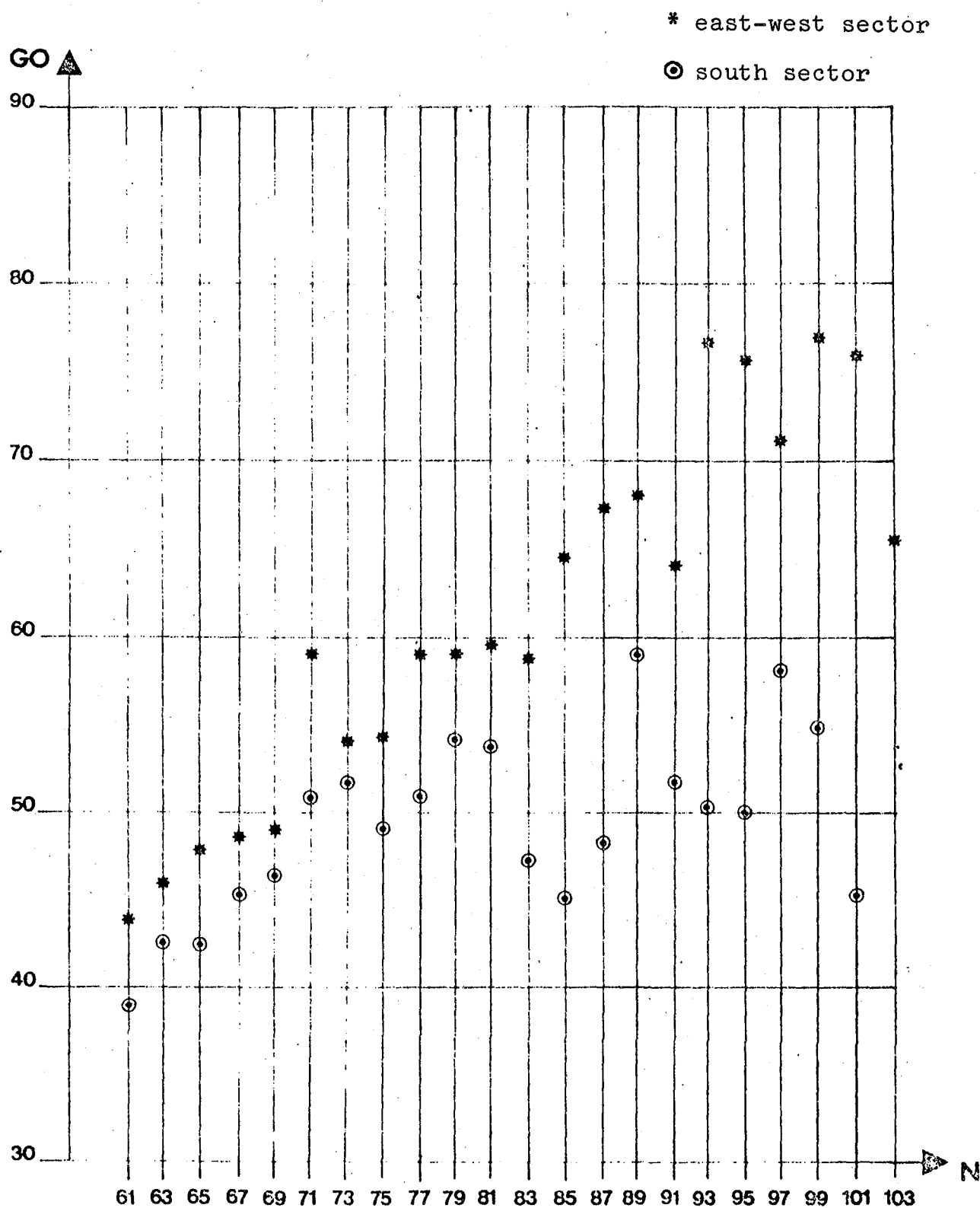
⊙ south sector

# ANNOYANCE CAUSED BY AIRCRAFT NOISE ACCORDING TO VALUES OF THE ISOPSOPHIC INDEX "N" IN THE EAST-WEST AND SOUTH SECTORS

east-west
south

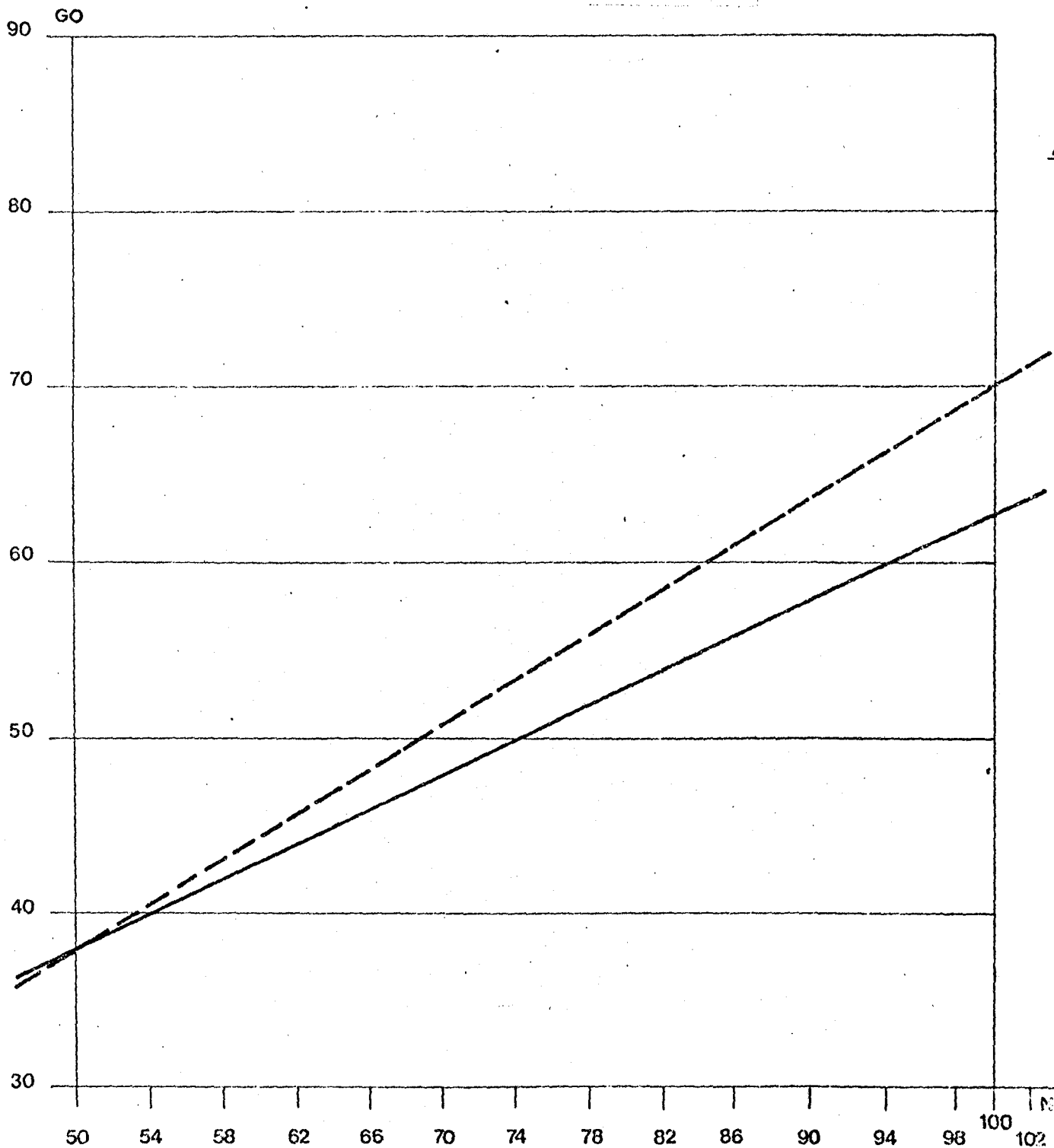## AIRCRAFT NOISE DISTURBS THEM GREATLY



## AIRCRAFT NOISE DISTURBS THEM VERY OFTEN



## INTENSITY OF AIRCRAFT NOISE HEARD   (VERY STRONG)



17

# REGRESSION LINES

For the entire inquiry zone



OLD METHOD

NEW METHOD

/13

18

REGRESSION LINES

OLD METHOD east–west
north–south

NEW METHOD east–west /14
north–south
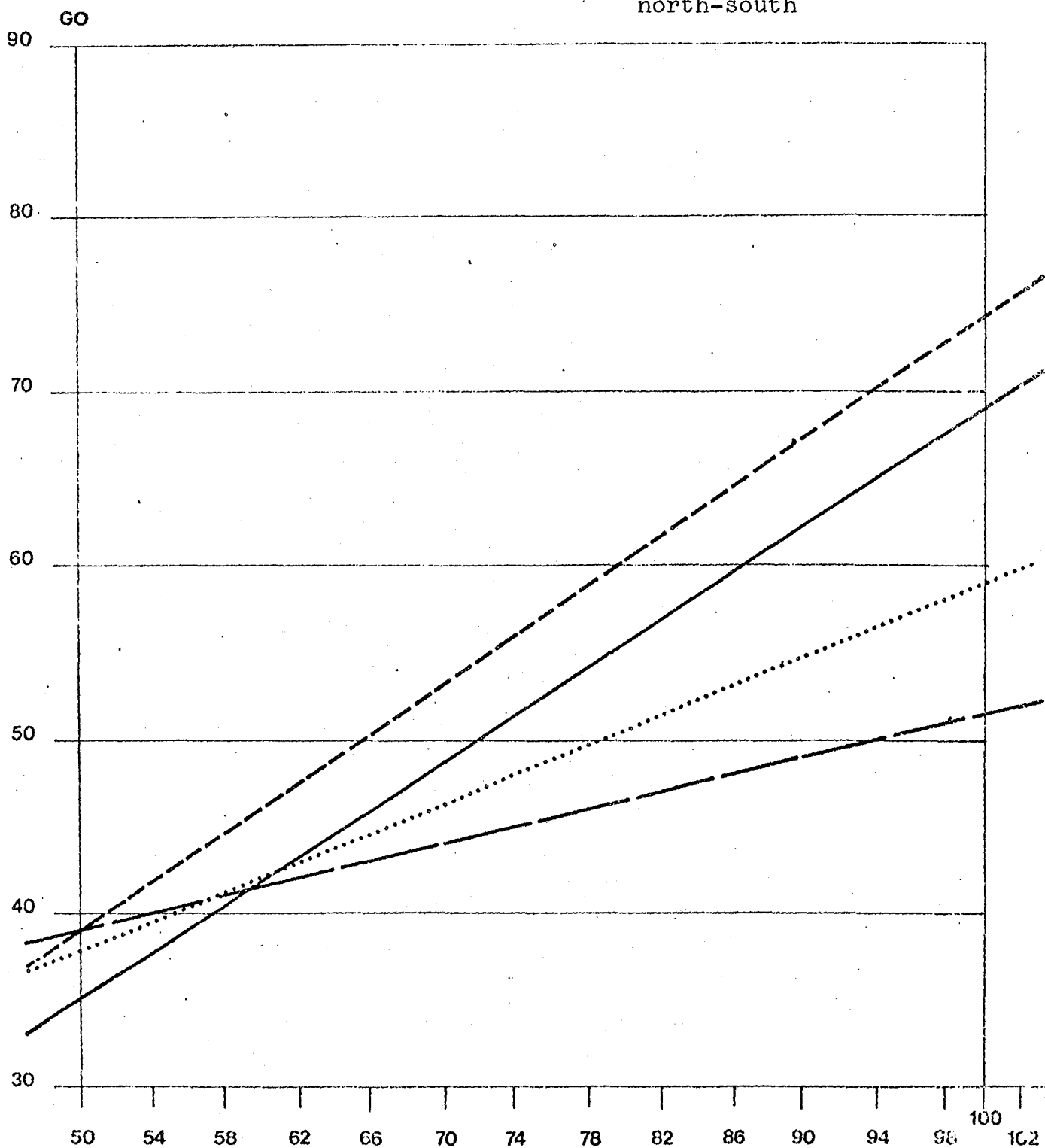
annoyance level and psophic index level, we can refer to the observations collected only along the east-west runway axis (as was done in the previous report), if we assume that for this axis the validity of N is most appropriate.

We then obtain the following table from the regression lines of GO with respect to N:

| Average Annoyance Levels: | VALUE OF PSOPHIC INDEX | | | |
| | Entire Inquiry Zone | | East-West Sector | |
| | Old Method | New Method | Old Method | New Method |
|---|---|---|---|---|
| Zero annoyance . . . . . . . | N < 55 | N < 53 | N < 58 | N < 51 |
| Weak annoyance . . . . . . . | 55 – 85 | 53 – 76 | 58 – 79 | 51 – 73 |
| Quite strong annoyance . . . | 85.105 | 76 – 92 | 79 – 94 | 73 – 87 |
| Strong annoyance . . . . . . | N > 105 | 92 – 99 | 94.101 | 87 – 94 |
| Very strong annoyance . . . | | N > 99 | N > 101 | N > 94 |

A graphic representation of this table of correspondence is given on the following page.

We can see in that diagram that the differences in the significance of the index in terms of annoyance in the east-west sector and in the entire zone are smaller than with the old method. We can see that for the east-west axis the modification of the calculation method resulted in a shift of 7 points in the index. For the entire inquiry zone, the shift between the two psophic indices increases and becomes very large for higher noise levels.

With the new method, the annoyance in the southern sector is not so much overestimated (increase in the slope of the regression line). The deviation between the significance of N for the entire zone of the inquiry and the significance in the east-west sector is smaller.

20

N

ENTIRE INQUIRY ZONE          EAST-WEST SECTOR

ANNOYANCE

VERY STRONG

STRONG

QUITE STRONG

WEAK

ZERO

110

100

90

80

70

60

50

OLD METHOD     NEW METHOD     OLD METHOD     NEW METHOD

21
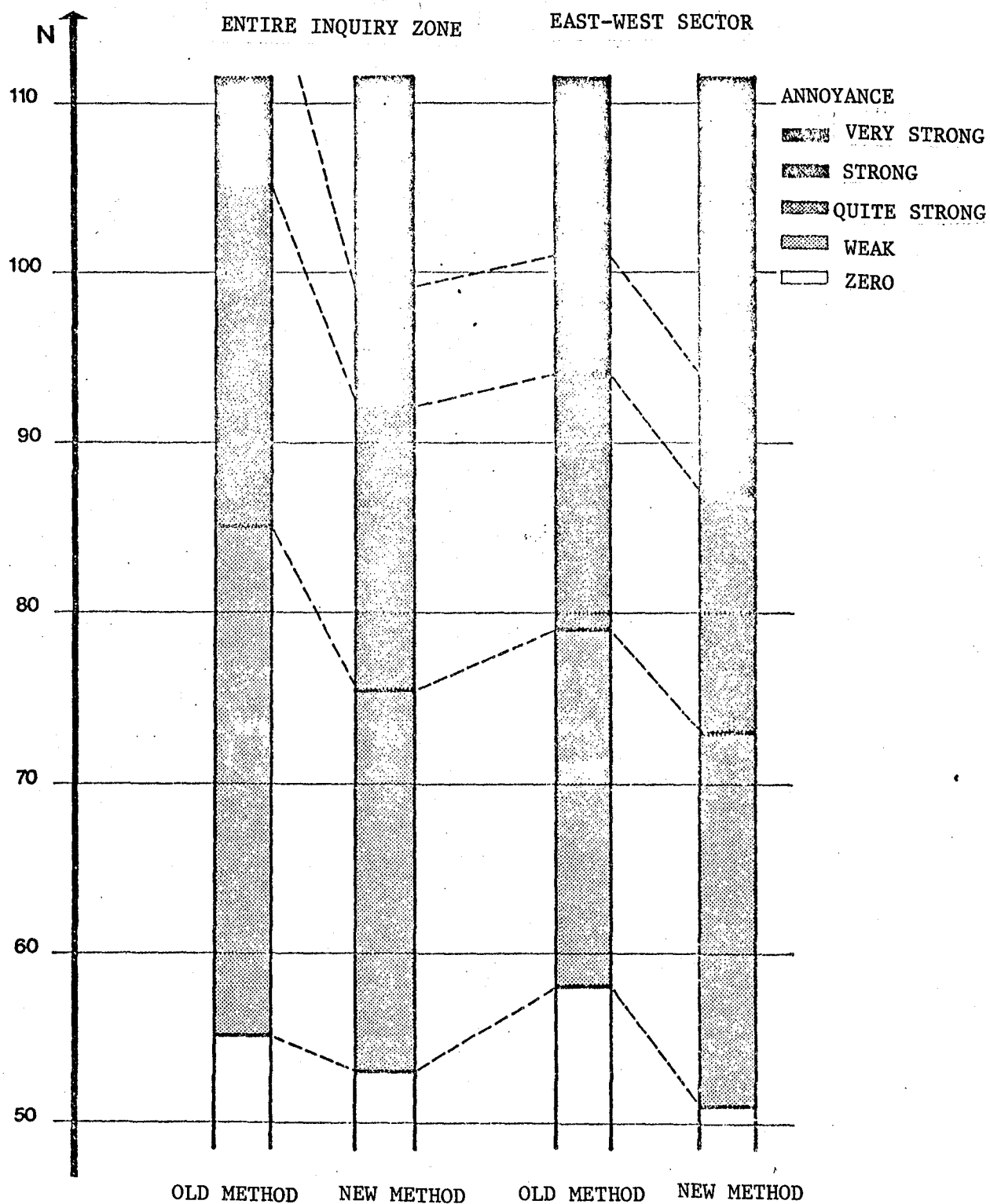
A graphic representation of the evolution of the annoyance as a function of the psophic index is given on the following page. We have distributed the variable GO into classes, and we have calculated for each class of N the percentage of individuals located in each class of GO. This figure was made by taking into account the entire inquiry zone.

We find a threshold for N = 71: the annoyance, which was zero or small up to now, appears suddenly after this value of N. The annoyance then increases in a rather regular manner:

-- After N = 77, more than half of the persons inter-
   rogated sensed a rather strong annoyance, strong
   annoyance or very strong annoyance.

-- Above N = 85, more than half of the persons inter-
   viewed sensed a strong annoyance, very strong or
   intolerable.

-- When N reached 93, the majority of the inhabitants
   sensed a very strong or intolerable annoyance.

/19

The index N was modified, and we must ask to what levels of annoyance the zones A, B and C now correspond, which are the bases of regulations of urban control around airports? For the entire inquiry zone, annoyance was distributed in the following way:
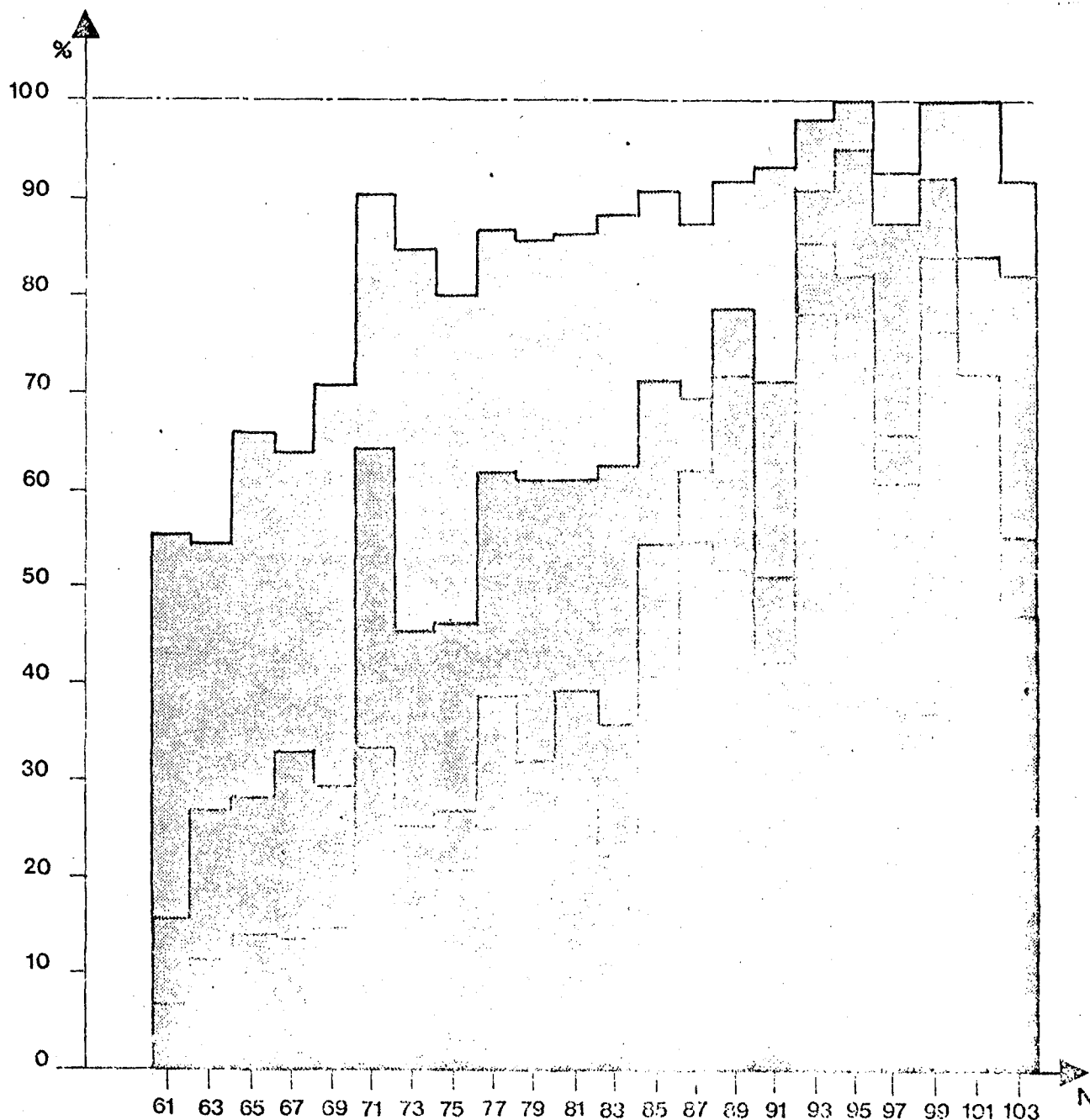
(see table on second page following)

VALUES OF GO

Less than 40 [ ] ZERO ANNOYANCE     40 to 54 [ ] WEAK ANNOYANCE     55 to 64 [ ] QUITE STRONG ANNOYANCE

65 to 69 [ ] STRONG ANNOYANCE     70 to 89 [ ] VERY STRONG ANNOYANCE     90 and above [ ] INTOLERABLE ANNOYANCE

| Values of N: | PROPORTION OF PERSONS DISTURBED ACCORDING TO THE LEVEL OF THE PSOPHIC INDEX | | | |
|---|---|---|---|---|
| | Zone A Greater than 96 | Zone B 89 to 96 | Zone A 84 to 89 | Zone B 80 to 84 |
| Proportion of airport vicinity in evidence that perceived annoyance as: | % | % | % | % |
| — Intolerable | 10 | 8 | 7 | 4 |
| — Intolerable or very strong | 47 | 57 | 38 | 25 |
| — Intolerable, very strong or strong | 53 | 66 | 51 | 36 |
| — Intolerable, very strong, strong or quite strong | 78 | 81 | 64 | 57 |

The four zones defined by the psophic index are sections
of a continuous phenomenon, and the sections are of necessity .
arbitrary. However, we can see that the distinction between zones
A and B does not correspond to a reasonable difference in the
annoyance level[1]. This non-differentiation seems to result
from the shrinking of the isopsophic curves, combined with
the size of the inter-individual variations in perceiving
annoyance.

On the other hand, the other zones define the distinct /20
annoyance levels well and are based on the finest index classes,

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[1] In the previous report, where we used the index N calculated with the old
method, the zone A was clearly distinguishable from zone B.

out of what could reasonably have been considered.

From the preceding table, we can summarize the signifi-
cance of the zones in terms of annoyance in the following way:

89 and + : More than half of the inhabitants of the
airport vicinity sensed a very strong or
intolerable annoyance.

84 to 89 : Half of them sensed a strong or more
intense annoyance.

80 to 84 : At least half of the inhabitants perceived
a rather strong or more intense annoyance.

It should be remarked that the values which defined the
zones A, B, C and "D" are illusory: we could also have based
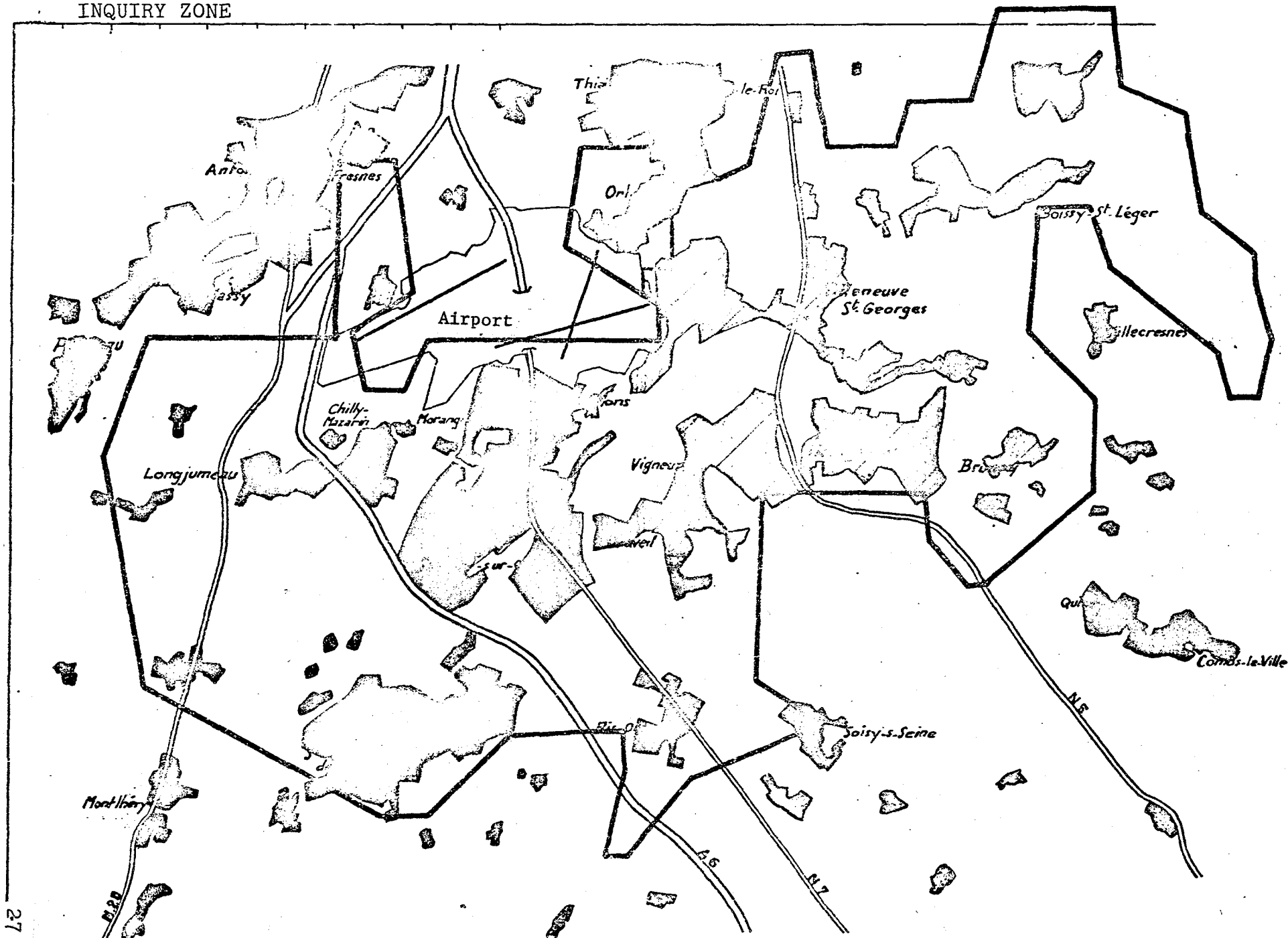them on the values of 80, 85 and 90.
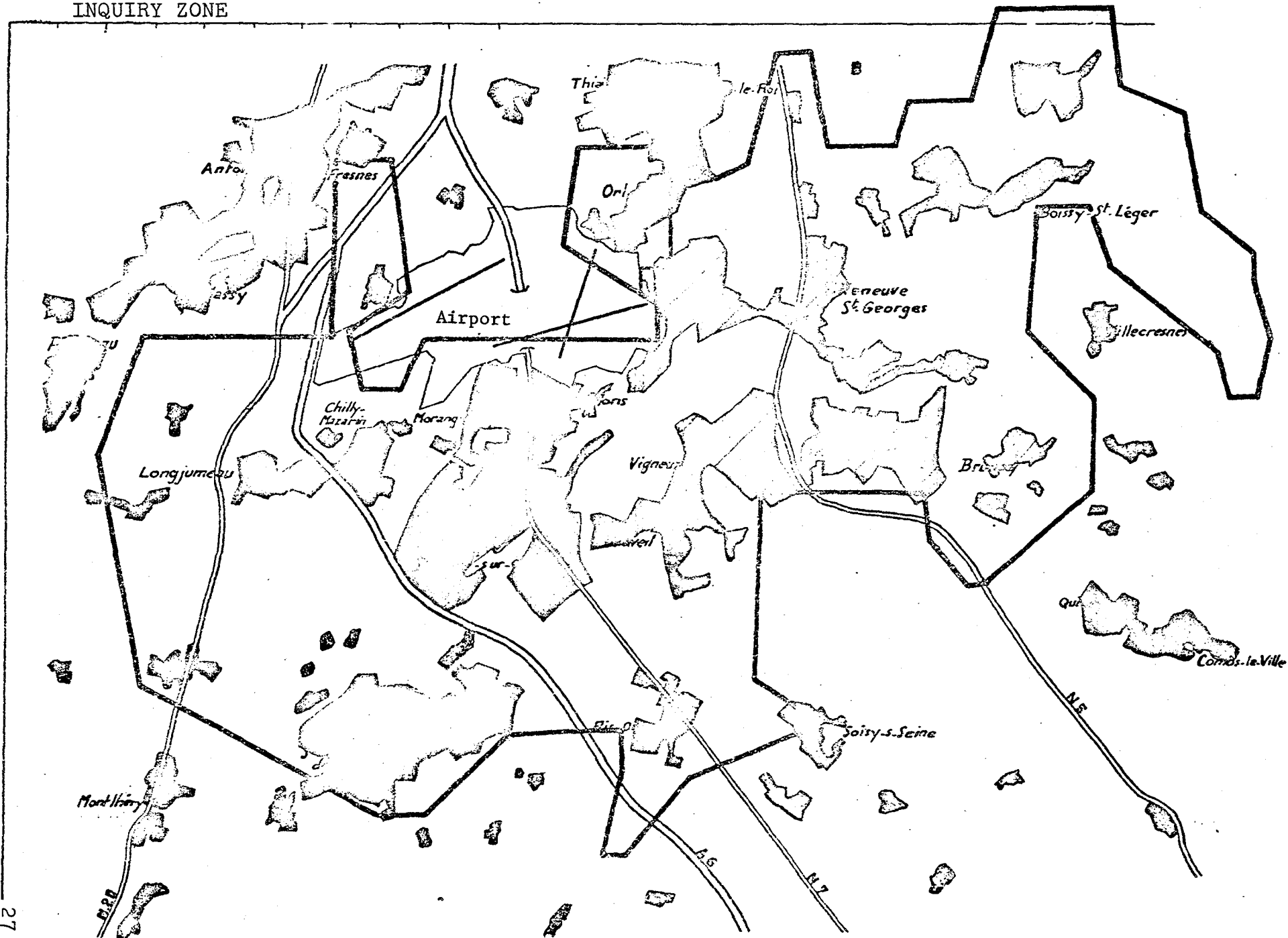
/21

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## A P P E N D I C E S

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The reader will find the following in these appendices:

-- Map of the zone covered by the inquiry.
-- Map of annoyance: in each square with a side length
-- of 333 m  where interviews could be performed, we
show the average note of annoyance of the five
persons interrogated.
-- Map of isopsophic  curves established according to
the old calculation formulae.

-- Map of the isopsophic curves established according to the new formula.

-- Map of the inquiry zone, indicating the manner in which it was cut up into sectors for the analysis of results.
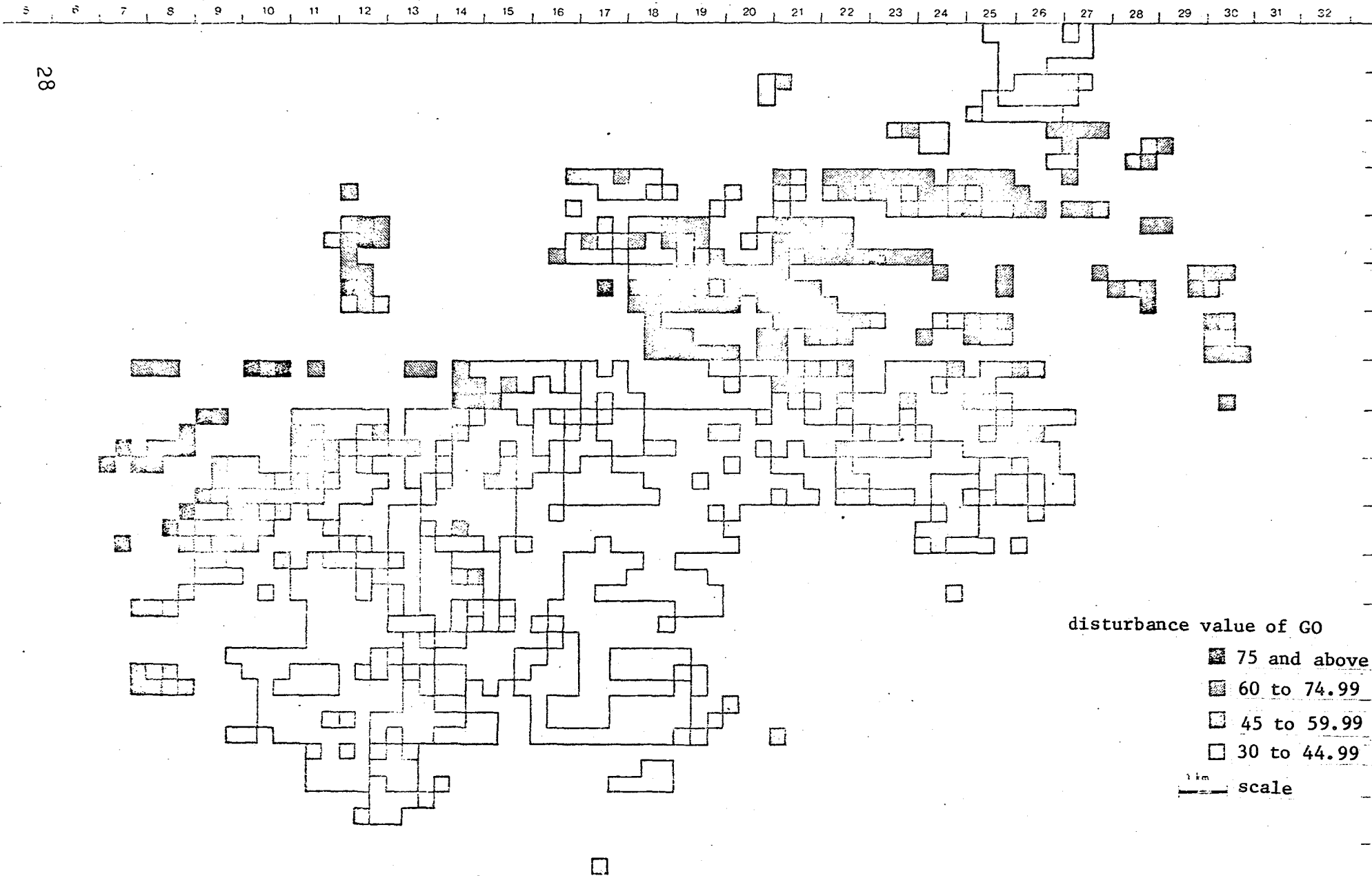
Thia

le-Roi

Anto

Fresnes

Ori

Soissy-St-Léger

assy

Airport

eneuve
St-Georges

P           u

illecresnes

Chilly-
Mazarin

Morang

ons

Longjumeau

Vigneu

Bro

avel

ur

Soisy-s-Seine

Qui

Combs-la-Ville

Bic-O

N6

Montlhéry

d

A6

N7

Scale: 1 cm per 1 km

Thia

le Roi

Anto

Fresnes

Orl

Boissy St. Léger

assy

eneuve
St. Georges

Airport

illecresnel

Chilly-
Mazarin

Morang

ons

Longjumeau

Vignes

Bri

rrel

ur-

Qu

Comos-le-Ville

Bie

Soisy-s-Seine

N.5

Montlhéry

A.6

N.7

Scale: 1 cm per 1 km

ANNOYANCE MAP (GO)

disturbance value of GO

▨ 75 and above

▨ 60 to 74.99

☐ 45 to 59.99

☐ 30 to 44.99

scale

PARIS ORLY AIRPORT

   ISOPSOPHIC CURVE  ESTABLISHED BY THE OLD METHOD
(Basis: 1971 traffic)

Curves for the indices: 96±1
                        89±1
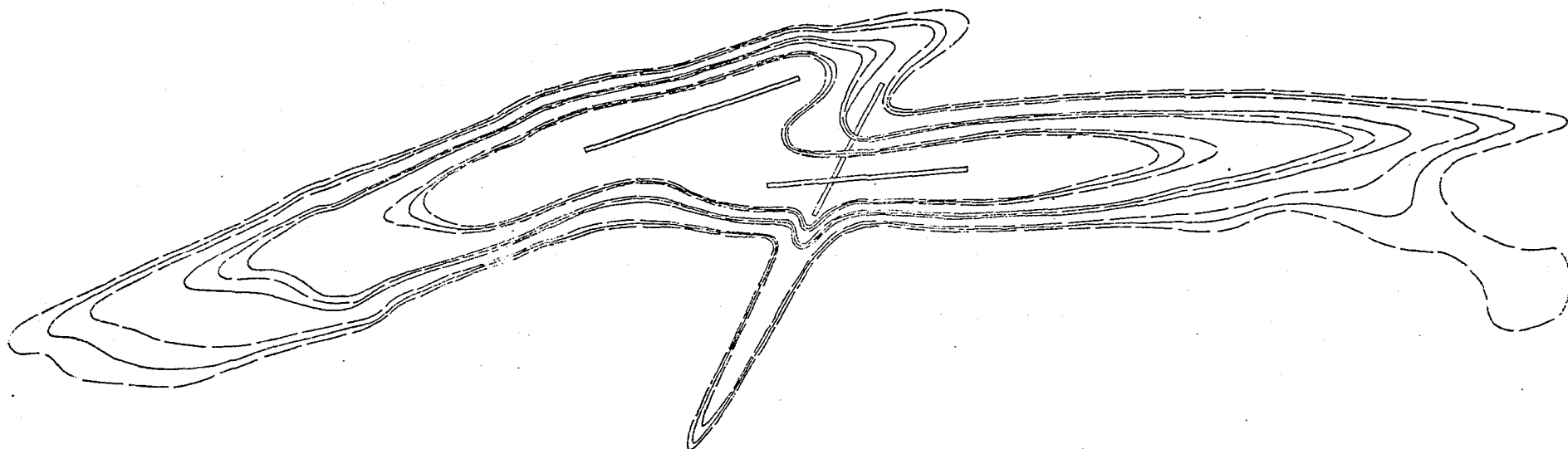                        84±1
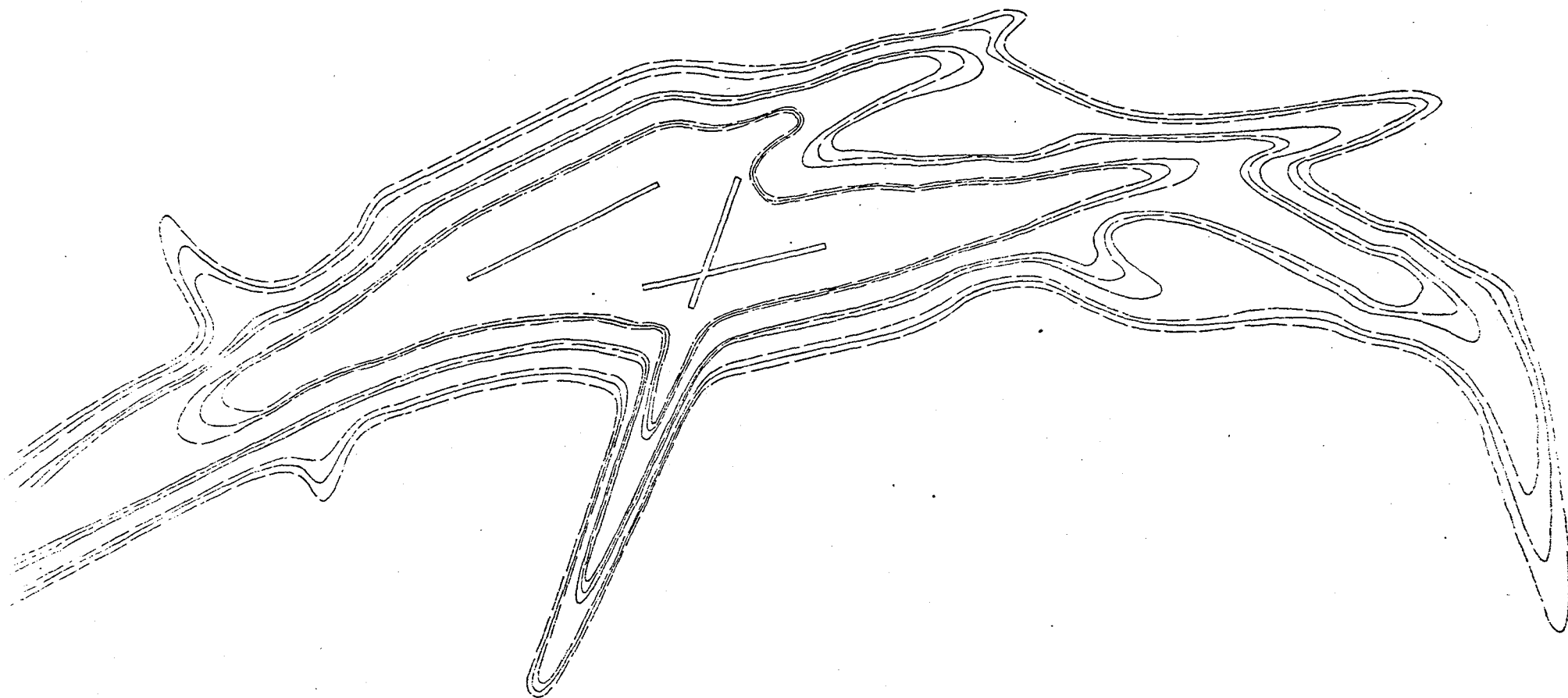
Scale  **1 km**

PARIS ORLY AIRPORT

ISOPSOPHIC   CURVES ESTABLISHED BY THE NEW METHOD
(Basis: 1971 traffic)
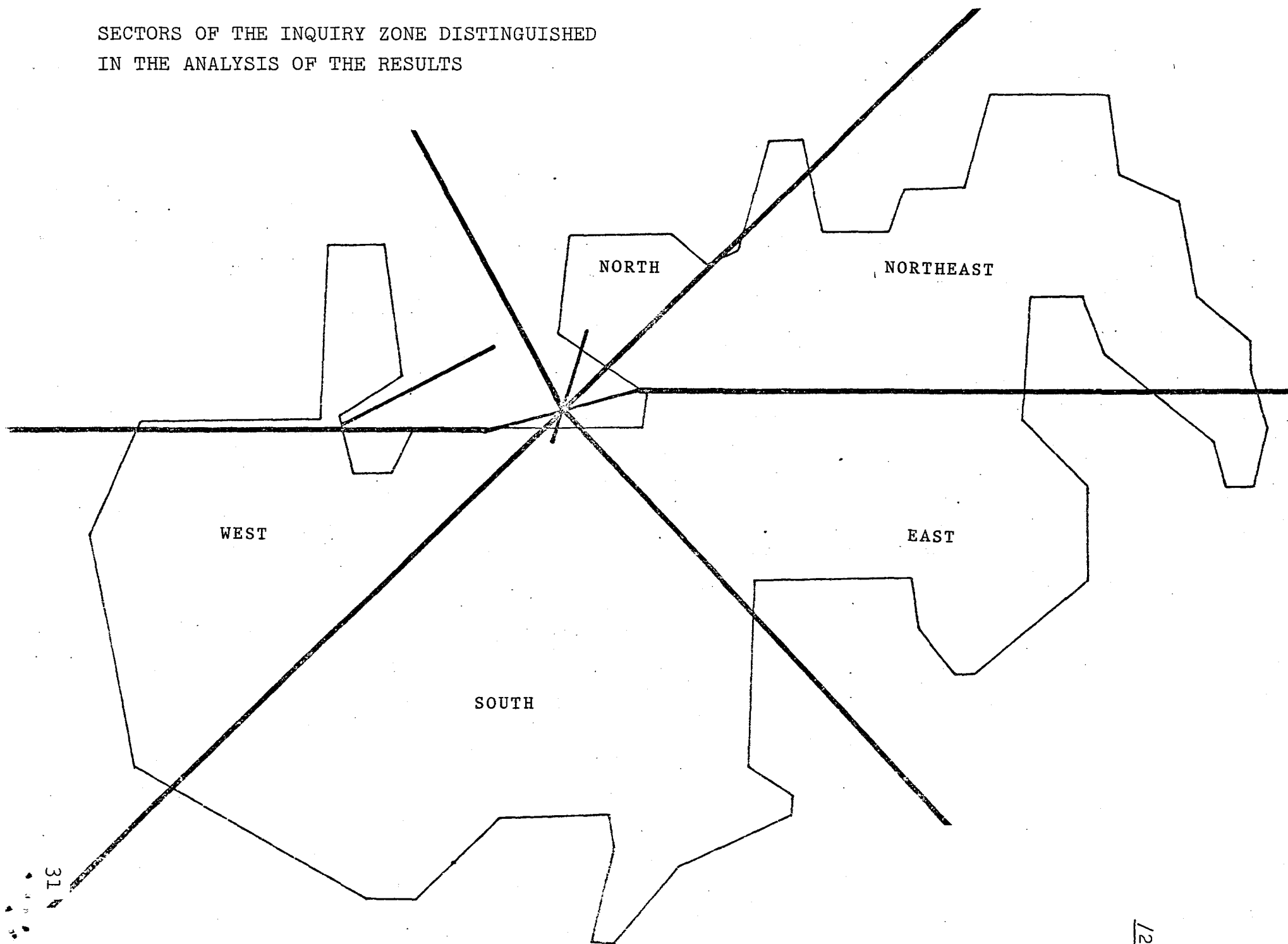
Curves for the indices:   96 ± 1
                          89 ± 1
                          84 ± 1

Scale  1 km

SECTORS OF THE INQUIRY ZONE DISTINGUISHED
IN THE ANALYSIS OF THE RESULTS



NORTH

NORTHEAST

WEST

EAST

SOUTH

Figure 1

32