THRESHOLD TESTING OF VESTIBULAR FUNCTION

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Introduction

MONTANDON (1961) defined the threshold of vestibular nystagmus, produced by angular acceleration, as "The minimal rotational acceleration sufficient to provoke, and to maintain, an ocular nystagmus which does not exceed the duration of the stimulus." This varies in normal subjects between accelerations of $0 \cdot 6^{\circ}/\text{sec.}^2$ to $1 \cdot 2^{\circ}/\text{sec.}^2$.

The routine use of an acceleration of $1 \cdot 0^{\circ}/\text{sec.}^2$ for 90 seconds as a testing method for vestibular function, at or near threshold level, was therefore initiated and described by Montandon and his co-workers (1955, 1960).

We have applied this method to 100 volunteers of different age-groups, all of whom were free of otological disease and none of whom gave a history of head trauma, or of having received treatment with known neuro-toxic drugs.

The equipment used was the Vestibulometric Girograph or "Girograph Liminaire" of Montandon and Dittrich (Fig. 1) and the nystagmus induced by rotation was recorded by Hellige electro-Nystagmographic Equipment with a time constant of 0·3 seconds and a gain of 5 microvolts per mm.

Clinical Material

Of the 100 subjects 56 were males and 44 females.

Age-Groups (years)	Males	Females
10-15	5	5
16-35	37	23
36-50	8	12
51-71	6	4
Totals	56	44

Threshold Values of Vestibular Function

The vestibular function threshold is arbitrarily related to the nystagmus induced by a constant rotational acceleration. It is the expression of the

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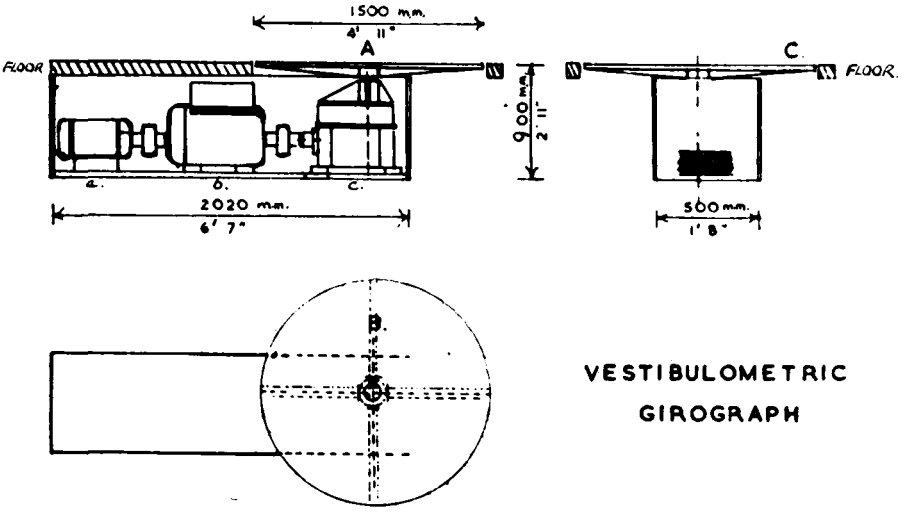


FIG. 1.
A represents a lateral view of the apparatus sunk in a pit three feet deep.
a. Electric motor.
b. Hydraulic motor.
c. Gearing mechanism.
B is a plan of the circular platform. The patient sits on a special chair in the centre of the platform.
C is the end view of the pit and platform.

periodicity of the nystagmus in terms of the stimulation time, e.g. an acceleration of 1°/sec.² will reach constant speed of 90°/sec. in 90 secs. If, during this period we can count one beat per second of nystagmus, this is equivalent to 90 beats in 90 secs. of stimulation time, and such is unit threshold. Similarly 180 beats in 90 secs. will give a threshold value of 0·5.

This definition was given by Montandon and his co-workers, who found an average Threshold Value of 0·8 in the 34 cases which they studied.

Statistical Results

1. *Threshold Values*

The general average bilateral threshold value for rotation to both L. and R. for all our cases was: 0·87.

Cases aged (years)	
10-15	0·96
16-35	0·83
36-50	0·81
51-71	0·88

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Variations by age-groups:

Cases aged	LEFT			RIGHT		
(years)	Minimum	Maximum	Av.	Minimum	Maximum	Av.
10-15	0·70	1·17	0·88	0·69	1·34	0·98
16-35	0·58	1·12	0·81	0·56	1·12	0·84
36-50	0·44	1·36	0·81	0·55	1·18	0·81
51-71	0·56	1·12	0·83	0·82	1·12	0·93

2. *Frequency*

The general average bilateral frequency of nystagmus for rotation to both L. and R. for all cases was: 1·23 cycles/sec.

Cases aged (years)	Minimum	Maximum	Average
10-15	0·74	1·45	1·07
16-35	0·89	1·78	1·23
36-50	0·73	2·35	1·28
51-71	0·89	1·96	1·20

3. *Culmination Amplitude*

This represents the angular degrees of eye movement.

The general average of bilateral amplitude of the nystagmus for rotation to both L. and R. was: 12 degrees.

Cases aged (years)	Minimum deg.	Maximum deg.	Average deg.
10-15	2·5	20·0	17·2
16-35	2·5	25·0	11·4
36-50	2·5	20·0	11·0
51-71	2·5	20·0	12·7

4. *Total Duration*

The general average duration of nystagmus for rotation to both L. and R. was: 103·5 secs.

Cases aged (years)	Minimum	Maximum	Average
10-15	94	111	102·4
16-35	92	128	102·5
36-50	88	146	103·0
51-71	93	120	101·2

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5. *Start-Lag*

We define this as the interval of time between the commencement of the stimulus and the first induced nystagmic beat. The general average start lag for all traces was: 0·7 secs.

Cases aged (years)	Minimum	Maximum	Average
10-15	0	5·0	0·7
16-35	0	6·0	0·9
36-50	0	3·0	0·6
51-71	0	3·0	0·4

6. *Over-Run*

We define this as the interval of time between the end of the stimulus and the last induced nystagmic beat. It is inversely proportional to the Start-Lag.

The general average over-run for all traces was: 11·0 secs.

Cases aged (years)	Minimum	Maximum	Average
10-15	3·0	18	10·3
16-35	0	42	11·1
36-50	0	47	11·6
51-71	0	29	8·4

Conclusions

The above results of Threshold Values broadly confirm those obtained by Montandon and his co-workers.

The narrow limits of these values are clearly shown by our figures and are confirmed in the diagrammatic Gauss distribution curve for biological constants (Fig. 2).

From our figures it is obvious that slightly asymmetrical threshold values are the normal pattern in cases studied in this manner. Further we have found that the R. sided reactions are less marked than the L. sided reactions. This asymmetry is not confined to the threshold values alone, but exists also in terms of frequency, amplitude and duration of nystagmus.

As reference to two papers (Montandon, 1961; Dittrich and Allen, 1965) will show, this asymmetry is not due to the equipment used.

Study of the reactions of the two sexes has not shown any evidence of significant statistical variation.

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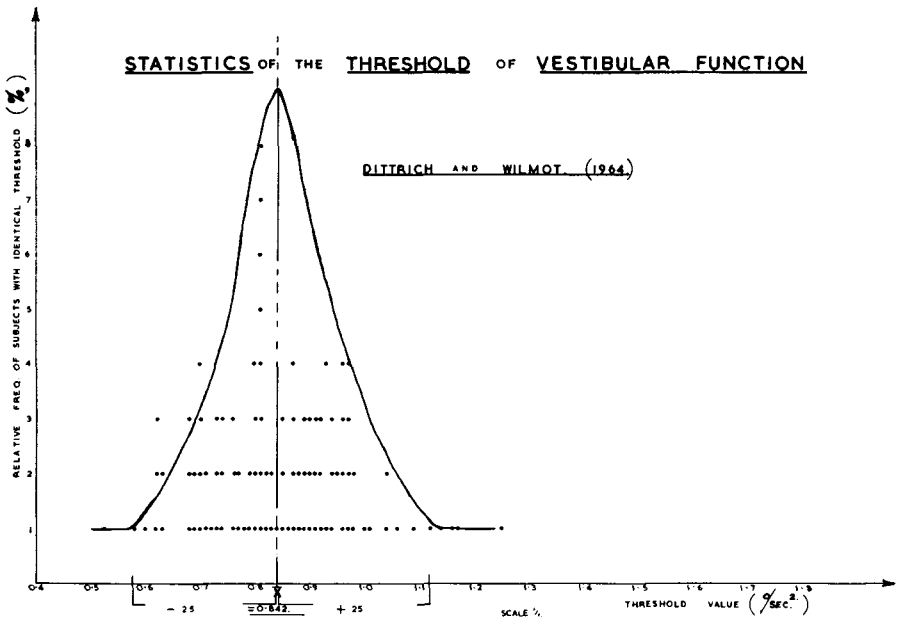


FIG. 2.
Shows the average bilateral Threshold Values of all (100) Normal Subjects. It will be seen that eight individuals have an identical Threshold Value of 0·81 and that the average value at the peak of the curve is 0·842 approximating very closely to the calculated overall average of 0·87.

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REFERENCES

DITTRICH, F. L. and ALLEN, R. H. (1965) In press.
MONTANDON, A, (1961) *Confin.Neurol. (Basel)*, **21**, 447.
——— and DITTRICH, F. (1961) *Acta oto-laryng. rhino-belg.*, **15**, 150.
——— and RUSSBACH, A. (1955) *Pract. oto-rhino-laryng. (Basel)*, **17**, 224.
———,——— and FUMEAUX, J. (1960) *Confin.Neurol. (Basel)*, **20**, 253.

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