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A STUDY OF
THE TYPE AND EXTENT OF HEARING LOSS OF SPEECH DEFECTIVE
CHILDREN IN THE ELEMENTARY SCHOOLS OF CACHE COUNTY AND OF
THE LOGAN CITY SCHOOL DISTRICTS

by

Merlin J. Meckam

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Speech Correction

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TABLE OF CONTENTS

	Page
LIST OF TABLES.....	iv
Chapter	
I. INTRODUCTION.....	1
A. The Problem	
B. A Review of the Literature	
C. Material	
D. Criteria	
E. Method	
F. Classification of Data	
II. DATA.....	9
A. General	
B. Per cent of hearing losses found	
C. Percentages of hearing loss found	
D. Types of losses found and their extent	
E. Types of speech defects and hearing loss found under each	
SUMMARY.....	28
CONCLUSIONS.....	31

LIST OF TABLES

Table 1.	Total number of speech defectives examined in the elementary schools of Logan and Cache County classified by grade and sex.....	10
Table 2.	Number of speech defective subjects examined and per cent who had hearing losses classified by grade and sex.....	12
Table 3.	Percentage of loss for each speech defective subject with a hearing loss classified by grade.....	14
Table 4.	Number of speech defective subjects examined and per cent who had a hearing loss classified by type of loss, grade, and sex.....	17
Table 5.	Percentage of loss for each speech defective subject with a hearing loss classified by type of loss and grade.....	18
Table 6.	Number of speech defective subjects examined and per cent who had a hearing loss classified by type of defect, grade, and sex.....	22
Table 7.	Percentage of loss for each speech defective subject with a hearing loss classified by type of defect and grade.....	23
Table 8.	Number of <u>articulation</u> speech defective subjects examined and per cent who had a hearing loss classified by type of loss, grade, and sex.....	24
Table 9.	Percentage of loss for each articulation speech defective subject with a hearing loss classified by type of loss and grade.....	25
Table 10.	Number of <u>phonation</u> and <u>rhythm</u> speech defective subjects examined and per cent who had a hearing loss classified by type of loss, grade, and sex.....	26
Table 11.	Percentage of loss for each <u>phonation</u> and <u>rhythm</u> speech defective subject with a hearing loss classified by type of loss and grade.	27

INTRODUCTION

A. The Problem

Many articles and textbooks which have recently been written in the field of speech correction indicate that a high per cent of all children who have speech defects also have a hearing deficiency. Some even say that a higher per cent of these children have hearing deficiencies than do children who are normal in speech.

Because of the great interest which has been aroused in the nature of the problems of the speech defectives, and because of the desire which exists for them to be helped in their handicaps, there is a necessity for their problems to be understood as thoroughly as possible. The present investigation has therefore been undertaken to establish the type and extent of hearing loss in the speech defective children in the first six grades of the elementary schools of Cache County and of the Logan City school districts.

B. A Review of the Literature

There is much disagreement among the authorities as to the relation between hearing acuity and speech defects.

Barnes (4) in testing a university freshman class with a Western Electric 4-A audiometer, found no relationship between auditory acuity and speech defects.

Hall (5) tested a university freshman class and a group of elementary school children with a Western Electric 2-A audiometer. In his study, functional articulatory defectives

were checked against normal speaking people and the speech defectives were not found to be inferior to normal speakers in hearing acuity.

Hagarty and Miller (18) made a study of 118 women students enrolled in a speech clinic. A hearing test was given to each defective with a Maico D-9 pure-tone audiometer. Of the 118 women tested, 81.4 per cent had normal hearing in both ears, 14.4 per cent had a slight deviation from the 20 decibel norm used, and 4.2 per cent had subnormal hearing in one or both ears.

Gaines' study (7) of losses found in 44 cleft palate cases indicated that they had a greater hearing loss than 44 functional articulation cases. This was accredited to disturbances of the eustachian tubes.

Harns and Malone (6) administered pure-tone tests to 62 consecutively observed stutterers. Hearing losses were found by the investigators ranging from 10 to 22 per cent in all cases. The conclusions that were arrived at stated that most of the 62 cases had more than likely had normal hearing originally and, therefore, a beginning in normal speech development, but that due to an onset of hearing loss and the confusion which resulted, stuttering was developed.

Sullivan (8) made a study of 25,708 elementary school children in Minnesota who had been given individual pure-tone audiometric hearing tests, 1,501 of whom were found to be speech defectives. She found that of the 24,207 children

who had no speech defects, 18.8 per cent had a hearing loss of 10 decibels or more in one or both ears, 12.9 per cent of which were found in frequencies above 4,000. Of the 1,501 children who had speech defects, 22.2 per cent had a hearing loss of 10 decibels or more in one or both ears, 13.8 per cent of which were found on frequencies above 4,000 d.v.s.

Stinchfield and Young (9) conclude from their studies that children with delayed or defective speech often score lower on hearing tests than children with normal or superior speech, and that reduced acuity is directly related to defective speech.

Johnson (10) maintains that about 7 per cent of school children have hearing loss which needs remedial attention, but makes no mention as to what per cent of the speech defectives have a loss in hearing acuity.

West, Kennedy, and Carr (2), Van Riper (3) Backus (11) Travis (12), and others all claim that there are many speech defectives with hearing problems, but none of them give any definite indication as to the extent or type of hearing losses found among the speech defective group.

None of the investigations which have been made show enough agreement to allow one to draw a definite conclusion as to extent or type of hearing loss found among the speech defectives. However, there is an indication that many of the speech defectives have a definite hearing handicap. It is thought, therefore, that the present study might lead to

some definite conclusions on the hearing problems of the speech defectives in the locality which has been surveyed by the present investigator.

C. Material

The subjects used in this study include 196 speech defective children of the first six elementary school grades. Just those defectives who are in need of clinical attention will be considered.*

The apparatus used in testing these subjects was a Maico D-5 pure-tone audiometer. This audiometer operates on 110 to 120 volts, 60 cycles, AC. It is an instrument of precision for measuring the field of human hearing in terms of both the loudness of sounds and the pitch or frequency. The D-5 model produces octave and half octave frequencies as follows: 64, 128, 256, 512, 1024, 2048, 2896, 4096, 5792, 8192, and 11582 cycles per second. These tones can be selected at will by the rotation of the knob which controls the frequency production. The loudness of the tones is indicated in decibel steps of intensity ranging from -10 decibels to 100 decibels. A desired intensity of each frequency can be obtained by the rotation of the intensity control knob (see figure 1).

D. Criteria

A speech defect, according to Van Riper (3), is speech which "deviates so far from the speech of other people that it calls attention to itself, interferes with communication, or causes its possessor to be maladjusted." Those speech

*See explanation of clinical attention under criteria.

defectives who are considered in this study as in need of clinical attention are the children who have been diagnosed by a speech correctionist as having a speech defect which is serious enough to call for remedial training in a speech clinic.

Speech defects may be divided into four classifications: (1) articulatory, (2) phonatory, (3) rhythmic, and (4) those of symbolic association.

Authorities (2, 16, 17,) say that a threshold which requires more than fifteen or twenty decibels of intensity might interfere with the perception of normal speech. Therefore, those subjects which have an intensity diminution of 15 decibels or more from zero on the audiometer, on any frequency in one or both ears, will be considered to have a great enough hearing loss to be classed in this study as hard of hearing.

E. Method

The method of the present investigation to find the facts as they prevail follows the normative-survey type. This method (1) is comprised of many procedures, but the one used exclusively in this study is the procedure which involves the survey-testing. This procedure consists of the "testing of a group of children (or adults) to ascertain the prevailing condition with respect to the traits measured by the test."

It was decided that the investigator would go into the elementary schools and administer to each speech defective

an individual hearing test on a Naico D-5 pure-tone audiometer. In order that the tests might be administered under the most controlled conditions possible, arrangements were made with the principals of the various schools to use the room in the building which would be the most ideal for testing. The room which was considered to be most ideal for the administration of the test was the one most removed from playgrounds, traffic, other outside noises, and all inside noise such as other rooms, hallways, drinking fountains, telephones, motors, and etc. Teachers and principal of each school cooperated in maintaining as much quiet as possible throughout the entire building during the testing period.

The tests were administered in two parts. The preliminary test was a "sweep" test, set at 15 decibels, of all frequencies on the audiometer from 256 up to and including 4096. Experiments (13, 14, 15), have shown that an elimination of frequencies above or below this range does not seem to distort sounds enough to hinder their intelligibility. The child being tested would signal when the tone was heard by nodding his head. The order in which the frequencies were tested was from low to high with some tones being repeated with a considerable variation in the time element between them to guard against possible malingering.

A second test was given to those defectives who failed to hear one or more of the frequencies in either ear at fifteen decibels in the "sweep" test. If they failed the

second time they were given a very thorough test on every audiometric frequency in the speech range and an audiogram record was made on each ear.*

F. Classification of Data

The hearing deficiencies were classified according to three types, high frequency loss, low frequency loss, and loss on combination high and low frequencies. For convenience in this study it was decided that all frequencies below 1024 inclusive would be considered low frequencies, and any above 1024 would be considered high frequencies. The extent of hearing loss was determined by calculating the percentage of total hearing loss for each ear as well as showing the combined percentage loss of both ears.

The formula used in calculating percentage of loss was that adopted by the House of Delegates of the American Medical Association, published in their journal (19), and used by the Maico Company for calculating percentage of hearing loss.** In this formula, each frequency is given a rated value in per cent with relationship to its importance in speech. Each step of five decibels in intensity on each frequency is also given a weighted rating.*** The threshold of hearing on each frequency on an audiogram is given a percentage of loss rating by the use of this formula. This is done for each ear. Taking one ear into consideration at a time, the percentage

*See addendum for an audiogram of each case, illustration No. 1.

**The Maico calculator, based on the A.M.A. formula, was used to calculate the percentage of loss for each subject found to have a hearing loss.

***See addendum, illustration No. 2.

value for all frequency thresholds are then added together. The percentage of hearing loss for each ear can be computed in this way.

To get the combined percentage of loss of both ears, the per cent loss of the better ear is multiplied by seven and is added to the per cent loss of the poorer ear. This sum is then divided by eight and the resulting quotient gives the combined percentage of loss.

The formula then can be expressed as follows:

$$\frac{\text{Loss of better ear} \times 7 + \text{loss of worse ear}}{8} = \text{total hearing loss.}$$

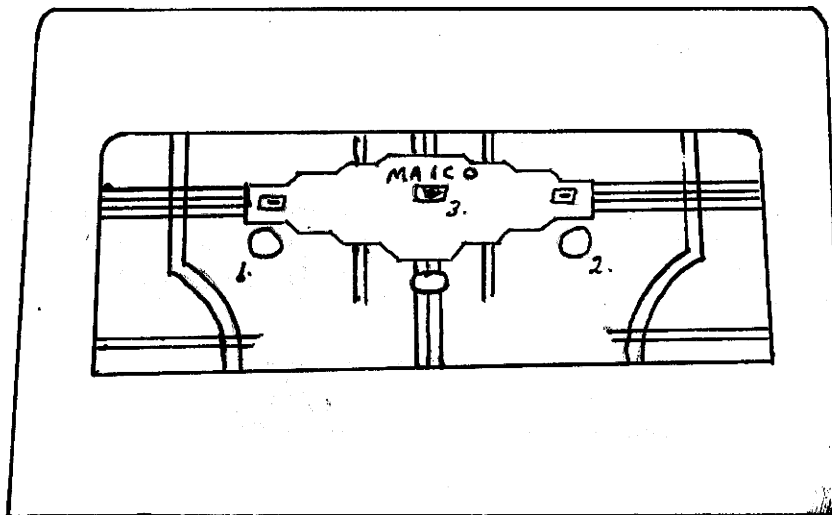


Fig. 1. Sketch of the Maico D-5 Audiometer
Panel
1. Attenuator; 2. Frequency control dial;
3. Signal light.

DATA

A. General

One hundred ninety-six speech defectives from 21 elementary schools were given an individual audiometric hearing test. As shown in table 1, there were 137 boys and 59 girls.

The greatest number of speech defectives examined were found in the first grade and the second, third, fifth, fourth, and sixth grades followed in the order listed.

As shown in table 1, the first grade had 41 boys. There were 37 boys in the second, 18 in the third, 17 in the fourth, 15 in the fifth, and 9 in the sixth. The first grade also had the greatest number of speech defective girls with a total of 18. The sequence of the other grades for the girls was 15 in the second, 10 in the fifth, 9 in the third, 6 in the fourth, and 1 in the sixth.

Table 1. Total number of speech defectives examined in the elementary schools of Logan and Cache County classified by grade and sex

Grade	Boys	Girls	Total
1	41	18	59
2	37	15	52
3	18	9	27
4	17	6	23
5	15	10	25
6	9	1	10
Total	137	59	196

B. Per cent of hearing losses found

Table 2 shows that 8.67 per cent of the speech defectives examined gave an indication of some hearing loss. It will be remembered that a hearing loss is regarded in this study as an impairment of acuity for the hearing of speech.*

The grade having the highest per cent of speech defective boys examined who had hearing losses was the fifth which had 26.6 per cent. The grades ranking next in per cent for the boys were the third with 16.6 per cent, the fourth with 11.8 per cent, the second with 5.4 per cent, and the first with 4.8 per cent. None of the sixth grade boys examined were found to have hearing losses.

The number of girls having hearing losses was 6.7 per cent of the group examined. The grade having the highest per cent of speech defective girls who had hearing losses was the fifth where 30 per cent of those examined had losses. The only other grade in which speech defective girls were found who had hearing losses was the first where 5.5 per cent had impaired hearing.

*See criteria, Chapter I.

Table 2. Number of speech defective subjects examined and per cent who had hearing losses classified by grade and sex

Grade		Boys	Girls	Both
1	Number examined	41	18	59
	Per Cent	4.8	5.5	5.1
2	Number examined	37	15	52
	Per Cent	5.4	0.0	3.8
3	Number examined	18	9	27
	Per Cent	16.6	0.0	11.1
4	Number examined	17	6	23
	Per Cent	11.8	0.0	8.7
5	Number examined	15	10	25
	Per Cent	26.6	30.0	28.0
6	Number examined	9	1	10
	Per Cent	0.0	0.0	0.0
Total	Number examined	137	59	196
	Per Cent	9.48	6.7	8.67

C. Percentages of hearing loss found.

Table 3 shows the percentage of hearing loss for each subject, as calculated by the formula used.*

The percentages of hearing loss ranged from one-tenth per cent to 42.6 per cent. Three cases had a loss in only the right ear and 6 cases had a loss in only the left ear. Eight cases were found to have a loss in both ears.

The greatest decibel loss on any frequency was found in case No. 13, who had a loss of 100+ decibels** in the left ear at the 2896 and the 4096 frequencies.*** In this study a larger number of the individuals examined showed a greater extent of loss in the left ear than in the right.

*See classification of data, Chapter I.

**100+ means that the individual could not hear the sound on 100 decibels of intensity.

***For a summary of the thresholds of hearing of each subject who had a hearing loss see illustration 3, in the addendum.

Table 3. Percentage of loss for each speech defective subject with a hearing loss classified by grade

Grade	Subject	Percentage of Hearing Loss		
		Left	Right	Both
1	1	0.0	2.4	.3
1	2	1.3	1.8	1.3
1	3	14.5	11.3	11.7
2	4	9.4	3.6	4.3
2	5	4.1	0.0	.5
3	6	8.8	0.0	1.1
3	7	4.4	0.0	.5
3	8	27.2	0.0	3.4
4	9	15.7	0.0	1.9
4	10	4.7	2.5	2.7
5	11	54.6	0.0	6.8
5	12	23.5	12.7	14.0
5	13	12.8	7.6	8.2
5	14	0.0	15.7	1.9
5	15	53.8	41.2	42.6
5	16	63.9	6.6	13.7
5	17	0.0	1.1	.1

D. Types of losses found and their extent.

Subjects in this investigation who had hearing losses fell into one of the three types of hearing loss: (1) high frequency, (2) low frequency, or (3) combination high and low frequency loss.

(1) High frequency loss

Table 4 shows that only 2 per cent of the 196 subjects examined showed losses on tones above 1024 cycles per second. Two and two-tenths per cent of the 137 boys examined had losses in the high frequencies. The highest per cent of speech defective boys having high frequency losses were found in the 3rd grade, where 5.5 per cent had this type of hearing loss.

Only 1.7 per cent of the 59 girls examined had high frequency losses. The grade which had the highest per cent of girls examined with this type of hearing loss was the first, which had a total of 5.5 per cent. Table 5 shows the percentage of loss for each case with a hearing loss of the high frequency type, and it is seen that the total percentages of loss ranged from three-tenths per cent to 4.3 per cent.

(2) Low frequency loss

Only one 5th grade boy out of all the subjects examined showed a low frequency loss. This one case was five-tenths per cent of the subjects examined. This subject, had a hearing loss in the right ear only which registered a 1.1 per cent loss. This gave the subject a total loss of one-tenth

per cent.

(3) Combination high and low frequency loss

Six and one-tenth per cent of the subjects examined had combination high and low frequency type losses. There were more subjects who had hearing losses of the combination high and low frequency type than there were in either of the other two types.

The boys again rated higher in per cent of losses than the girls with 6.6 per cent of the 137 boys examined showing combination high and low frequency losses. The grade having the highest per cent of boys with hearing losses of a combination high and low frequency type was the fifth, which had 20 per cent. In the group of 59 girls examined, there were 5.1 per cent who had combination high and low frequency losses. The grade having the highest per cent of girls showing hearing losses of the combination high and low frequency type was the fifth, in which 30 per cent had a loss.

The percentages of loss in the combination high and low frequency type ranged from five-tenths per cent to 42.6 per cent. The percentages of loss in the left ears ranged from zero to 63.9 per cent while in the right ears they ranged from zero to 41.2 per cent.

Table 4. Number of speech defective subjects examined and per cent who had a hearing loss classified by type of loss, grade, and sex

Grade		High Frequency Loss			Low Frequency Loss			Combination High & Low Freq. Loss		
		Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
1	No. Exam.	41	18	59	41	18	59	41	18	59
	Per Cent	2.4	5.5	3.4	0.0	0.0	0.0	2.4	0.0	1.7
2	No. Exam.	37	15	52	37	15	52	37	15	52
	Per Cent	2.7	0.0	1.9	0.0	0.0	0.0	2.7	0.0	1.9
3	No. Exam.	18	9	27	18	9	27	18	9	27
	Per Cent	5.5	0.0	3.7	0.0	0.0	0.0	11.1	0.0	7.4
4	No. Exam.	17	6	23	17	6	23	17	6	23
	Per Cent	0.0	0.0	0.0	0.0	0.0	0.0	11.8	0.0	8.7
5	No. Exam.	15	10	25	15	10	25	15	10	25
	Per Cent	0.0	0.0	0.0	6.7	0.0	4.0	20.0	30.0	24.0
6	No. Exam.	9	1	10	9	1	10	9	1	10
	Per Cent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	No. Exam.	137	59	196	137	59	196	137	59	196
	Per Cent	2.2	1.7	2.0	0.7	0.0	0.5	6.6	5.1	6.1

Table 5. Percentage of loss for each speech defective subject with a hearing loss classified by type of loss and grade

Grade	Subject	High Frequency Loss			Low Frequency Loss			Combination High and Low Frequency Loss		
		Left	Right	Both	Left	Right	Both	Left	Right	Both
1	1	0.0	2.4	.3						
1	2	1.3	1.8	1.3						
1	3							14.5	11.3	11.7
2	4	9.4	3.6	4.3						
2	5							4.0	0.0	.5
3	6	8.8	0.0	1.1						
3	7							4.4	0.0	.5
3	8							27.2	0.0	3.4
4	9							15.7	0.0	1.9
4	10							4.7	2.5	2.7
5	11				0.0	1.1	.1			
5	12							54.6	0.0	6.8
5	13							23.5	12.7	14.0
5	14							12.8	7.6	8.2
5	15							0.0	15.7	1.9
5	16							53.8	41.2	42.6
5	17							63.9	6.6	13.7

E. Types of speech defects and hearing losses found under each.

A study of the relationship between the types of speech defects and the hearing losses found under each indicated as wide a diversity in range as has been found in comparing the types of hearing losses. This relationship between hearing losses and speech defects does not necessarily suggest that a certain type of hearing loss is indicative of a certain type of speech defect. A correlation of this type is beyond the scope of this study. The data found in tables 6, 7, 8, 9, 10, and 11 show the type and extent of hearing losses found under each type of speech defect as follows:

(1) Articulation defects

Seven and nine-tenths per cent of the 164 articulation subjects were found to have hearing losses. Seven and eight-tenths per cent of the boys in the articulation group were found to have losses as compared to an 8.1 per cent of the girls.

The percentages of total loss for the individuals of the articulation group who had losses, ranged from one-tenth per cent to 42.6 per cent, with losses of the left ears ranging from zero to 63.9 per cent and the losses in the right ears ranging from zero to 41.2 per cent.

Two and four-tenths per cent of the articulation defectives examined had high frequency type losses.

Two and six-tenths per cent of the boy subjects examined gave evidence of high frequency losses while only 2 per cent

of the girl subjects examined were found with this type of loss. The range of total losses extended from three-tenths per cent to 4.3 per cent.

Only one boy within the articulation group was found to have a low frequency loss. He had a loss of 1.1 per cent in the right ear, no loss in the left, and a total of one-tenth per cent for both ears. Among the girls who had articulation speech defects none were found with low frequency losses.

Four and nine-tenths per cent of the articulation subjects examined had losses in a combination of high and low frequencies. Of these, 4.3 per cent were boys and 6.1 per cent were girls.

The percentages of total loss for the individuals with combination high and low frequency losses ranged from five-tenths per cent to 42.6 per cent, with the losses in the left ears ranging from 4.1 per cent to 63.9 per cent and the losses in the right ears ranging from zero to 41.2 per cent.

(2) Phonation defects

Eighteen and seven-tenths per cent of the 16 phonation subjects examined were found to have hearing losses and all of these were boys. No phonation subjects were found with either high or low frequency losses, but all of this group who were found to have hearing losses fell into the combination high and low frequency category. The percentages of total loss for the phonation subjects who had losses ranged from 1.9 per cent to 6.8 per cent with the losses of the left ears ranging

from zero to 54.6 per cent and the losses of the right ears ranging from zero to 15.7 per cent.

(3) Rhythm defects

There was a total of 5.5 per cent of the 18 rhythm subjects examined who had a hearing loss. One boy out of the rhythm subjects examined was found to have a hearing loss, and this loss was of the combined high and low frequency type. The total loss for this subject was 1.9 per cent with a 15.7 per cent loss in the left ear and no loss in the right ear. There were no girls in the rhythm group examined who were found to have a hearing loss.

Table 6. Number of speech defective subjects examined and per cent who had a hearing loss classified by type of defect, grade, and sex

Grade		Articulation *			Phonation			Rhythm		
		Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
		No. Exam.	No. Exam.	No. Exam.	No. Exam.	No. Exam.	No. Exam.	No. Exam.	No. Exam.	No. Exam.
1	No. Exam.	38	16	54	2	1	3	1	1	2
	Per Cent	5.3	6.3	5.5	0.0	0.0	0.0	0.0	0.0	0.0
2	No. Exam.	33	13	46	1	0	1	3	3	6
	Per Cent	6.1	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0
3	No. Exam.	17	5	22	1	3	4	1	1	2
	Per Cent	17.6	0.0	13.6	0.0	0.0	0.0	0.0	0.0	0.0
4	No. Exam.	12	5	17	1	1	2	4	0	4
	Per Cent	0.0	0.0	0.0	100.0	0.0	50.0	25.0	0.0	25.0
5	No. Exam.	9	9	18	4	1	5	2	0	2
	Per Cent	22.2	33.3	27.7	50.0	0.0	40.0	0.0	0.0	0.0
6	No. Exam.	6	1	7	1	0	1	2	0	2
	Per Cent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tot- al	No. Exam.	115	49	164	10	6	16	13	5	18
	Per Cent	7.8	8.1	7.9	30.0	0.0	18.7	7.67	0.0	5.5

* One articulation subject also had a phonation defect and was included under phonation. Another articulation subject also had a rhythm defect and was included under rhythm

Table 7. Percentage of loss for each speech defective subject with a hearing loss classified by type of defect and grade

Grade	Subject	Articulation			Phonation			Rhythm		
		Left	Right	Both	Left	Right	Both	Left	Right	Both
1	1	14.5	11.3	11.7						
1	2	0.0	2.4	.3						
1	3	1.3	1.8	1.3						
2	4	4.1	0.0	.5						
2	5	9.4	3.6	4.3						
3	6	4.4	0.0	.5						
3	7	27.2	0.0	3.4						
3	8	8.8	0.0	1.1						
4	9				4.7	2.5	2.7			
4	10				54.6	0.0	6.8			
4	11							15.7	0.0	1.9
5	12	23.5	12.7	14.0						
5	13	12.8	7.6	8.2						
5	14	53.8	41.2	42.6						
5	15	63.9	6.6	13.7						
5	16	0.0	1.1	.1						
5	17				0.0	15.7	1.9			

Table 8. Number of articulation speech defective subjects examined and per cent who had a hearing loss classified by type of loss, grade, and sex

Grade		High Frequency Loss			Low Frequency Loss			Combination High & Low Freq. Loss		
		Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
1	No. Exam.	38	16	54	38	16	54	38	16	54
	Per Cent	2.6	6.2	3.7	0.0	0.0	0.0	2.6	0.0	1.8
2	No. Exam.	33	13	46	33	13	46	33	13	46
	Per Cent	3.0	0.0	2.2	0.0	0.0	0.0	3.0	0.0	2.2
3	No. Exam.	17	5	22	17	5	22	17	5	22
	Per Cent	5.9	0.0	4.5	0.0	0.0	0.0	11.8	0.0	9.1
4	No. Exam.	12	5	17	12	5	17	12	5	17
	Per Cent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	No. Exam.	9	9	18	9	9	18	9	9	18
	Per Cent	0.0	0.0	0.0	11.1	0.0	5.5	11.1	33.3	22.2
6	No. Exam.	6	1	7	6	1	7	6	1	7
	Per Cent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	No. Exam.	115	49	164	115	49	164	115	49	164
	Per Cent	2.6	2.0	2.4	8.7	0.0	.61	4.3	6.1	4.9

Table 9. Percentage of loss for each articulation speech defective subject with a hearing loss classified by type of loss and grade

Grade	Subject	High Frequency Loss			Low Frequency Loss			Combination High and Low Frequency Loss		
		Left	Right	Both	Left	Right	Both	Left	Right	Both
1	1	0.0	2.4	.3						
1	2							14.5	11.3	11.7
1	3	1.3	1.8	1.3						
2	4	9.4	3.6	4.3						
2	5							4.1	0.0	.5
3	6	8.8	0.0	1.1						
3	7							4.4	0.0	.5
3	8							27.2	0.0	3.4
5	9				0.0	1.1	.1			
5	10							23.5	12.7	14.0
5	11							12.8	7.6	8.2
5	12							53.8	41.2	42.6
5	13							63.9	6.6	13.7

Table 10. Number of phonation and rhythm speech defective subjects examined and per cent who had a hearing loss classified by type of loss*, grade, and sex

Grade		Phonation			Rhythm		
		Comb. High & Low Freq. Loss			Comb. High & Low Freq. Loss		
		Boys	Girls	Both	Boys	Girls	Both
1	No. Exam. Per Cent	2 0.0	1 0.0	3 0.0	1 0.0	1 0.0	2 0.0
2	No. Exam. Per Cent	1 0.0	0 0.0	1 0.0	3 0.0	3 0.0	6 0.0
3	No. Exam. Per Cent	1 0.0	3 0.0	4 0.0	1 0.0	1 0.0	2 0.0
4	No. Exam. Per Cent	1 100.0	1 0.0	2 50.0	4 25.0	0 0.0	4 25.0
5	No. Exam. Per Cent	4 50.0	1 0.0	5 40.0	2 0.0	0 0.0	2 0.0
6	No. Exam. Per Cent	1 0.0	0 0.0	1 0.0	2 0.0	0 0.0	2 0.0
Tot- al	No. Exam. Per Cent	10 30.0	6 0.0	16 18.7	13 7.7	5 0.0	18 5.5

* There were no phonation or rhythm subjects with any type of hearing loss other than a combination high and low frequency type

Table 11. Percentage of loss for each phonation and rhythm speech defective subject with a hearing loss classified by type of loss and grade

Grade	Subject	Phonation			Rhythm		
		Comb. High & Low Freq. Loss			Comb. High & Low Freq. Loss		
		Left	Right	Both	Left	Right	Both
4	1				15.7	0.0	1.9
4	2	4.7	2.5	2.7			
5	3	54.6	0.0	6.8			
5	4	0.0	15.7	1.9			

SUMMARY

There were 196 speech defectives given an individual hearing test on a Maico D-5 audiometer. Of this number, 137 were boys and 59 were girls. These speech defectives included rhythm, articulation, and phonation subjects; there were no symbolization subjects in this group. Eight and sixty-seven-hundredths per cent of the speech defective subjects examined were found to have hearing losses which required a greater intensity than 15 decibels on one or more frequencies in one or both ears.

The speech defective boys examined were found to have a greater per cent who had losses than the speech defective girls. Nine and forty-eight-hundredths per cent of the boys and only 6.7 per cent of the girls examined were found to have hearing losses. The extent of the hearing losses ranged from one-tenth per cent to 42.6 per cent total loss. The left ears in this study had greater losses than did the right ears in most cases.

Two per cent of the group of speech defectives examined were found to have high frequency losses, that is, above the frequency of 1024 cycles per second. Here again the boys who had hearing losses outnumbered the girls who had hearing losses. Two and two-tenths per cent of the boys and 1.7 per cent of the girls had losses of the high frequency type. The percentages of total loss in this category ranged from

three-tenths per cent to 4.3 per cent.

Five-tenths per cent of the group examined had low frequency losses, that is, losses on 1024 cycles per second or below. Out of this group only one boy was found to have a low frequency type of loss. His total loss was one-tenth per cent.

Most of the subjects who had hearing losses fell under the combination high and low frequency type. Six and five-tenths per cent of the boys examined and 5.1 per cent of the girls examined, or a total of 5.1 per cent of the 195 subjects examined, fell into the combination high and low frequency type of hearing loss. The percentages of total loss in this category ranged from five-tenths per cent to 42.5 per cent.

Eighteen and seven-tenths per cent of the 16 subjects in the phonation group examined were found to have hearing losses. The phonation subjects had a greater per cent showing losses than either the rhythm or articulation groups. All losses found within this group were of the combination high and low frequency type. All of these were males. The extent of total losses ranged from 1.9 per cent to 6.8 per cent.

Of the 164 subjects examined in the articulation group, 7.9 per cent had hearing losses. Eight and one-tenth per cent of the articulation defective girls examined were found to have hearing losses, while only 7.8 per cent of the boys of this group showed any kind of a hearing loss. The type under which the highest per cent of articulation subjects who had a hearing loss fell was the combination high and low

frequency type (4.3 per cent). Two and four-tenths per cent of the articulation subjects examined had high frequency losses, while only sixty-one-hundredths per cent had losses of the low frequency type. The percentages of total loss for the whole articulation group examined ranged from five-tenths per cent to 42.6 per cent.

Out of the 18 rhythm speech defective subjects examined only one boy was found to have a hearing loss. This one boy was 7.6 per cent of the rhythm group examined. The hearing loss of this subject was of the combination high and low frequency type and totaled 1.9 per cent.

CONCLUSIONS

From the data obtained from those cases used in this investigation, the following are the conclusions:

1. The speech defectives do not have much greater extent of hearing loss (8.67 per cent) than that which is estimated for the children who are normal in speech (about 7 per cent).
2. The phonation cases seem to have a greater per cent who have a hearing loss than those with any other type of speech defect.
3. The greatest per cent of speech defectives have a hearing loss of the combination high and low frequency type.

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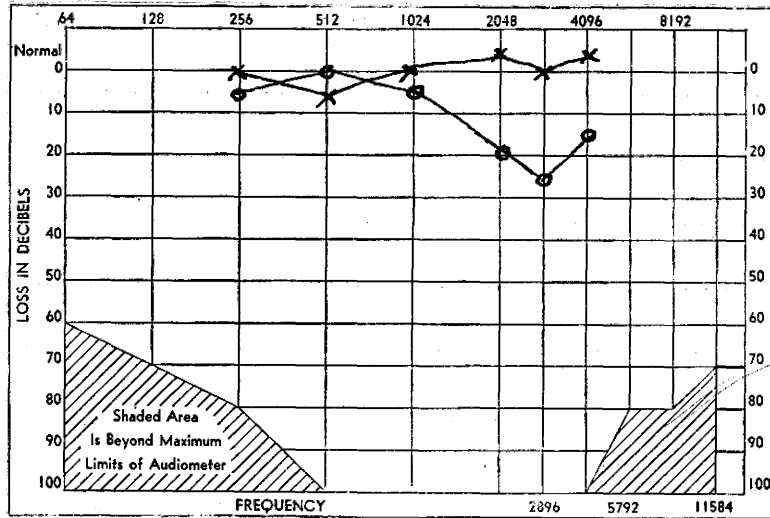
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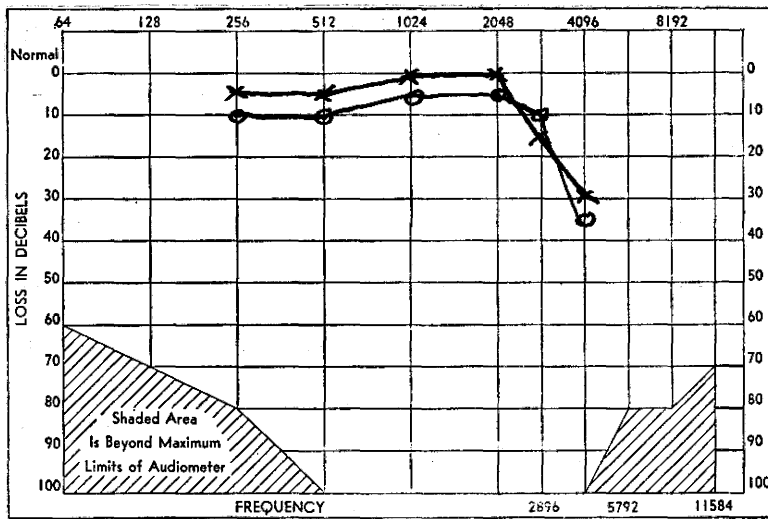
A D D E N D U M

Illustration No. 1. An audiogram on each speech defective subject examined who had a hearing loss*

Case 1.

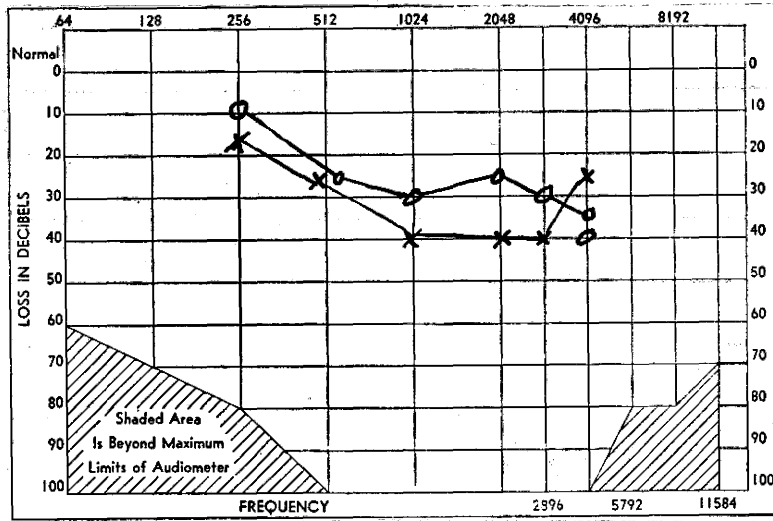


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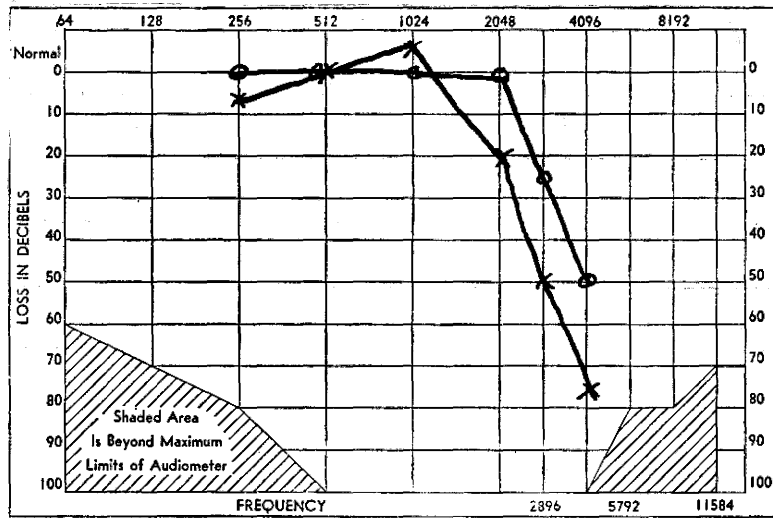


* x = left ear, and o = right ear

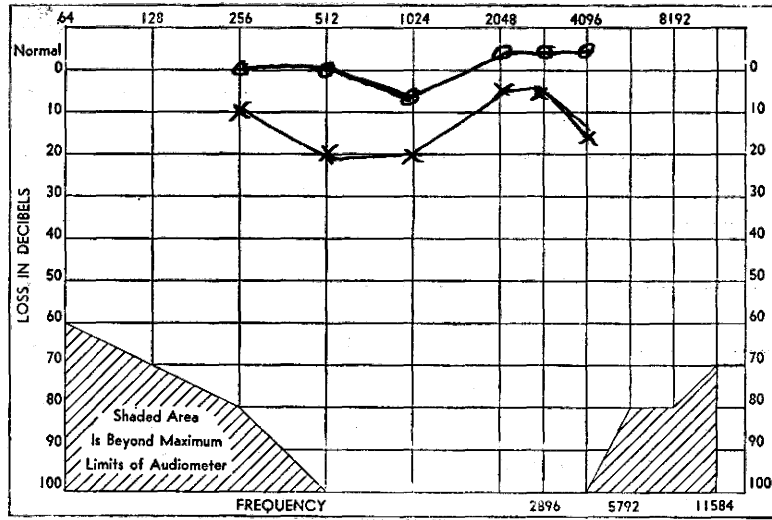
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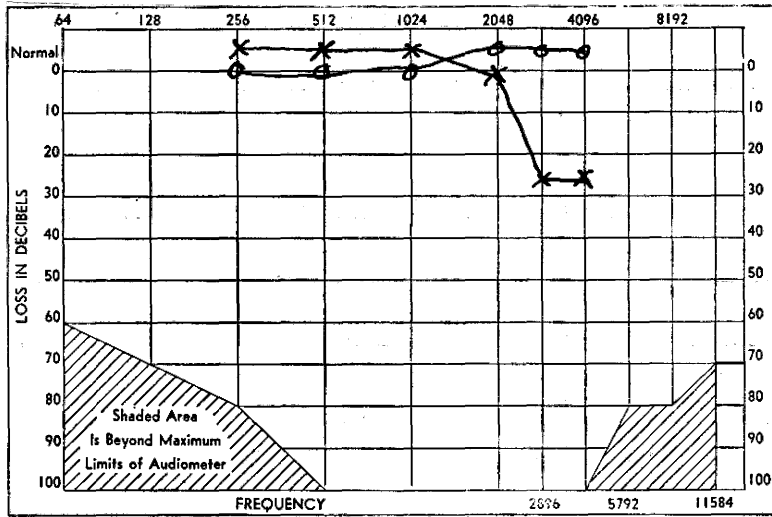
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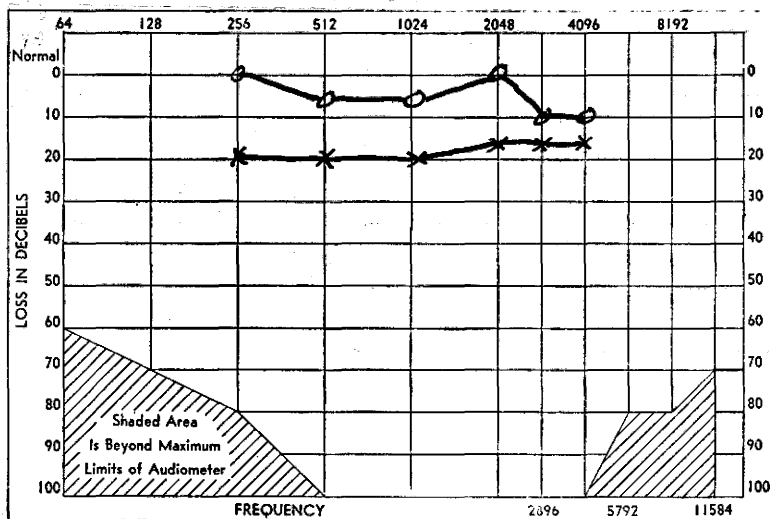
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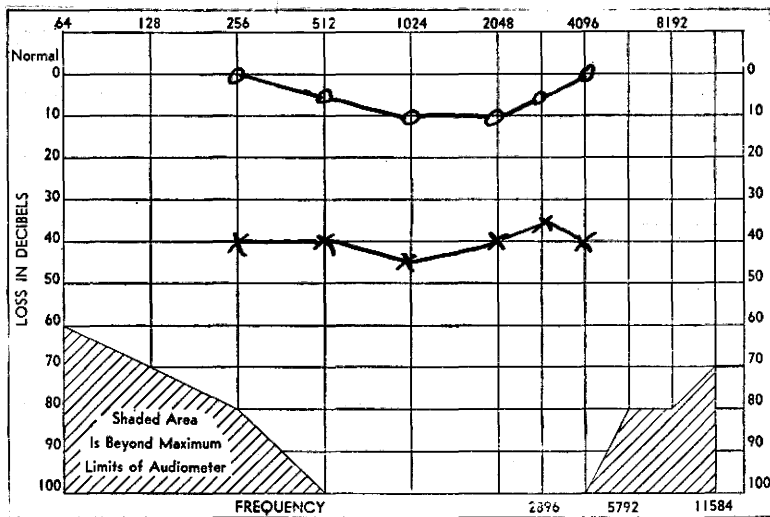
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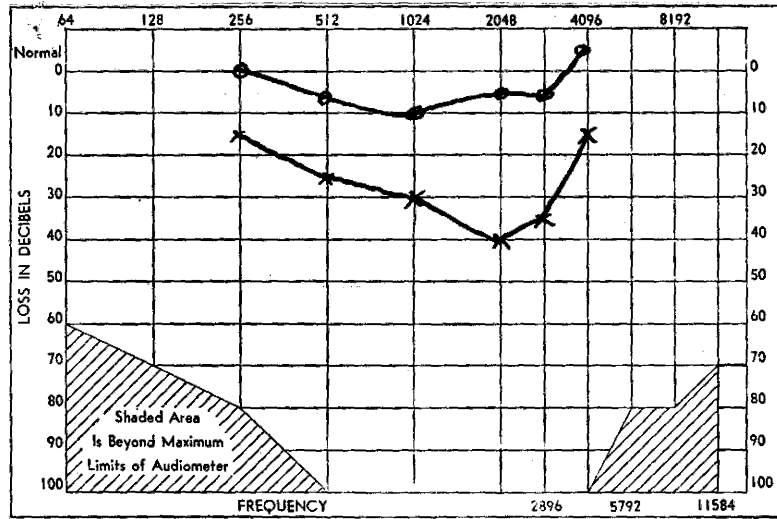
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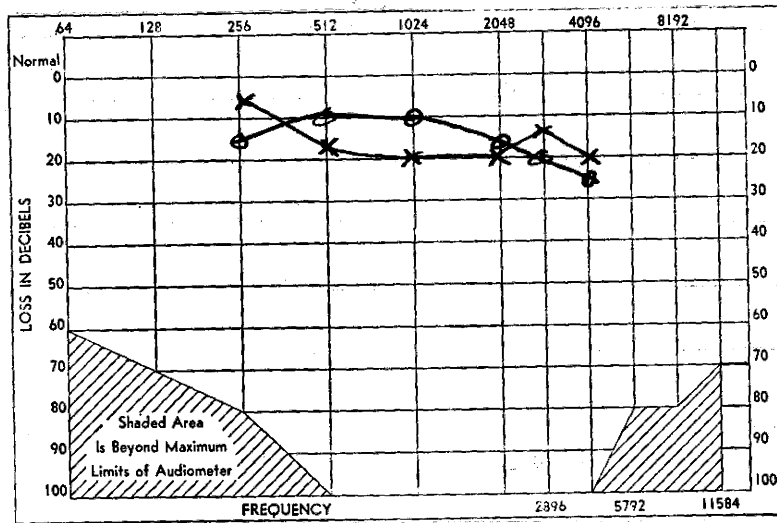
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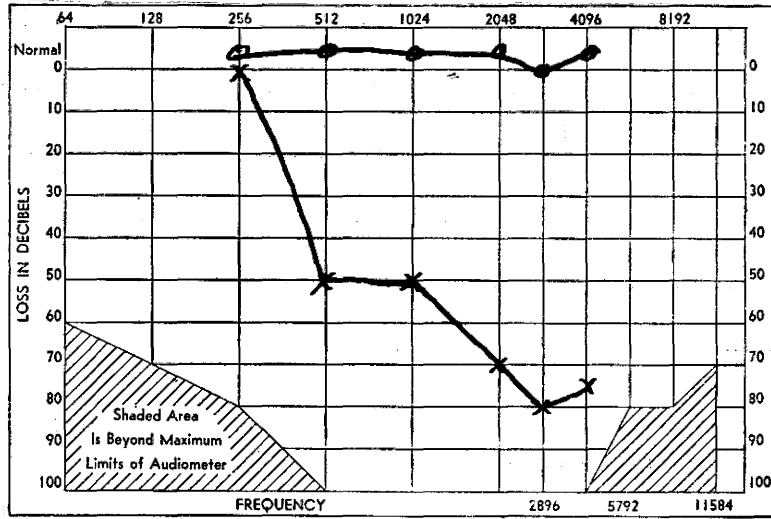
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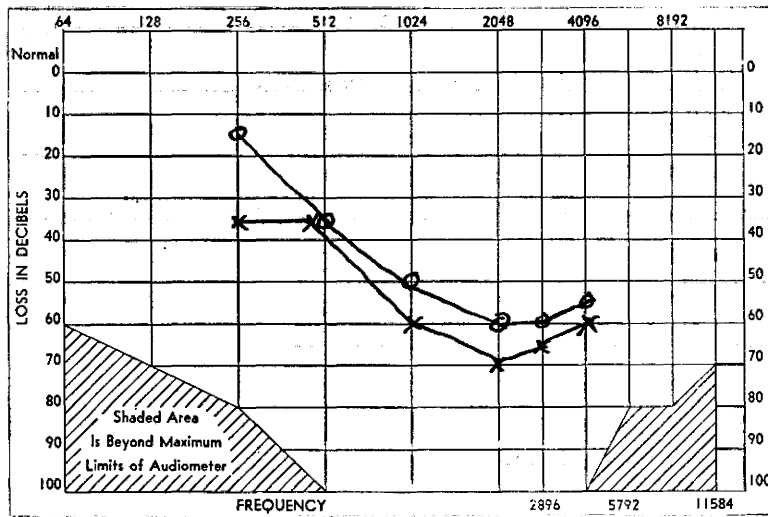
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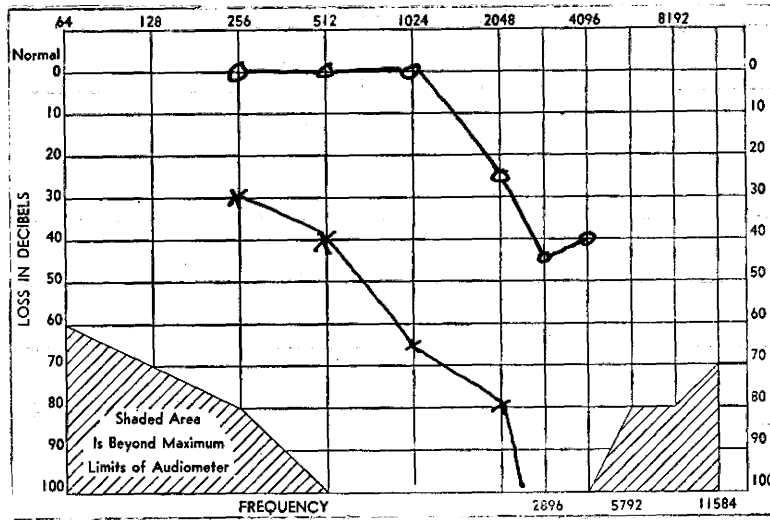
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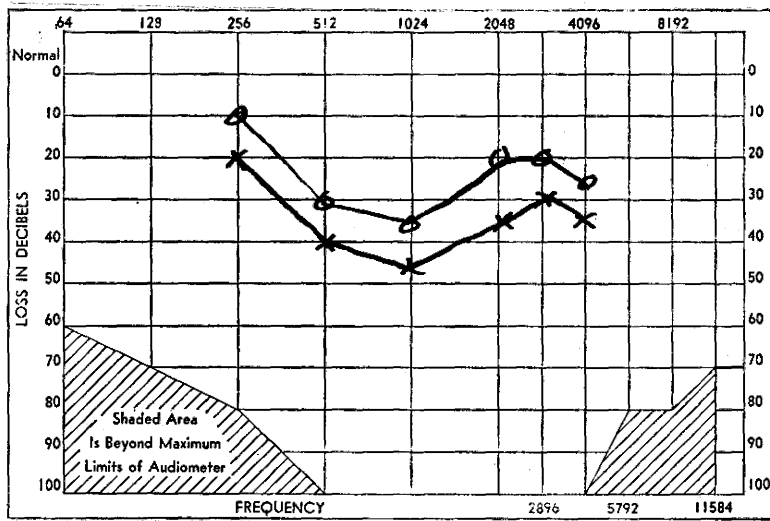
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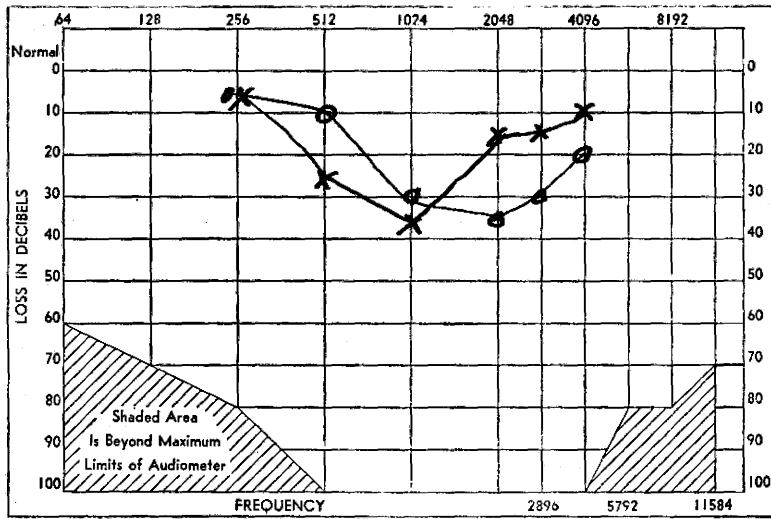
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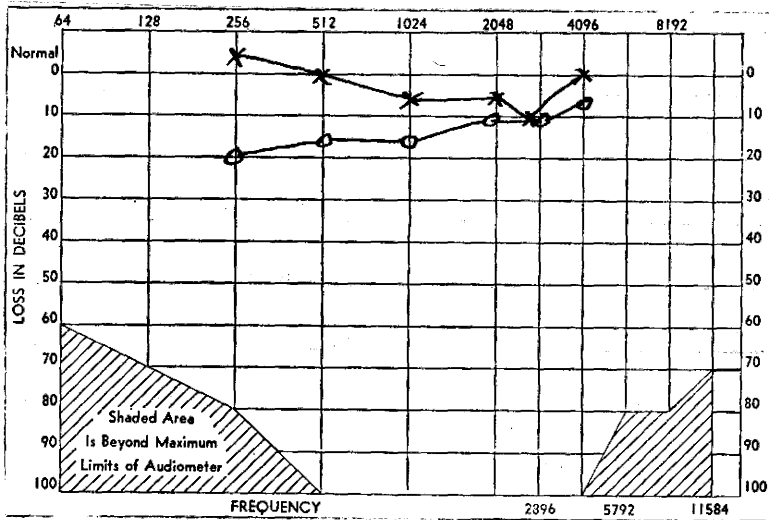
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Case 15.



Case 16.



Case 17.

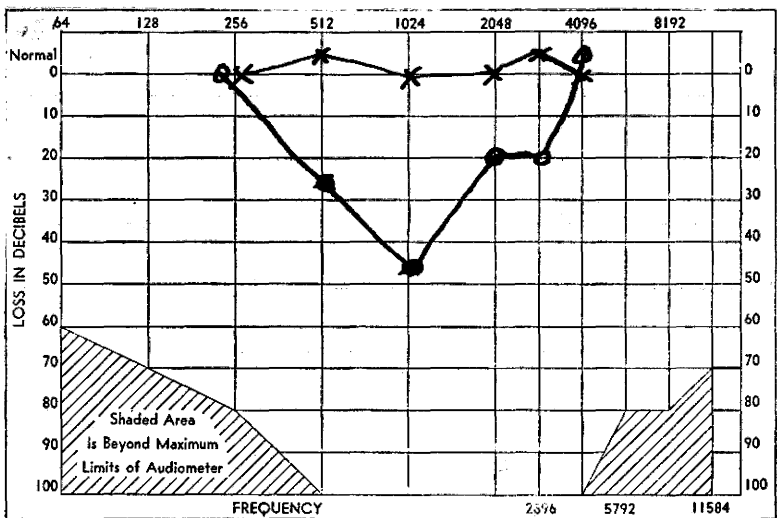


Illustration No. 2. Weighted percentage of loss of hearing

	128	256	70	512	90	1024	70	2048	70	4096	5792	8192	11584
	LOSS			LOSS			LOSS			LOSS			
10			0.3		0.8		1.2		0.5				
20			0.7		2.0		2.9		1.1				
			1.1		3.3		4.5		1.9				
30			1.6		4.9		6.7		3.1				
			2.4		6.5		8.7		4.3				
40			3.4		8.3		11.2		5.8				
			4.4		10.3		13.8		7.4				
50			5.8		12.4		16.6		9.0				
			7.2		14.8		19.5		10.9				
60			9.0		17.7		22.4		13.1				
			10.4		20.5		25.1		15.0				
70			12.1		23.0		27.7		16.5				
			13.6		25.3		29.8		17.6				
80			15.0		27.0		31.0		18.6				
					28.4		32.6		19.4				
90					30.0		34.0		20.0				
							35.0						
100													
			TOTAL LOSS										
			FOR SPEECH										

Loss in decibels

Illustration No. 3. Summary of the thresholds of hearing of each subject who had a hearing loss

Case	Grade	256		512		1024		2048		2896		4096	
		L	R	L	R	L	R	L	R	L	R	L	R
1	1 st	0	5	5	0	0	5	-5	20	0	25	-5	15
2	1 st	5	10	5	10	0	5	0	5	15	10	30	35
3	1 st	15	10	25	25	40	30	40	25	40	30	25	35
4	2 nd	5	0	0	0	-5	0	20	0	50	25	75	50
5	2 nd	10	0	20	0	20	5	5	-5	5	-5	15	-5
6	3 rd	-5	0	-5	0	-5	0	0	-5	25	-5	25	-5
7	3 rd	20	0	20	5	20	5	15	0	15	10	15	10
8	3 rd	40	0	40	5	45	10	40	10	35	5	40	0
9	4 th	15	0	25	5	30	10	40	5	35	5	15	-5
10	4 th	5	15	15	10	20	10	20	15	15	20	20	25
11	5 th	0	-5	50	-5	80	-5	70	-5	80	0	75	-5
12	5 th	35	15	35	35	60	50	70	60	65	60	60	55
13	5 th	30	0	40	0	65	0	80	25	100+	45	100+	40
14	5 th	20	10	40	30	45	35	35	20	30	20	35	25
15	5 th	5	5	25	10	35	30	15	35	15	30	10	20
16	5 th	-5	20	0	15	5	15	5	10	10	10	0	5
17	5 th	0	0	-5	25	0	45	0	20	-5	20	0	-5