

*Modern*  
**VISUAL TRAINING**  
*with*  
**ORTHO-FUSOR**



Technical Data

**BAUSCH & LOMB**  
OPTICAL CO., ROCHESTER, N. Y., U. S. A.

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*The Bausch & Lomb Ortho-Fusor set includes: Three Dimensional Polaroid Glasses, Vectograph series with complete instructions, and pocket-size case.*

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*The Ortho-Fusor can be used in the home, office or wherever there is good light for reading. The Polaroid Glasses are worn over the patient's regular eyewear.*

## CHAPTER I

# Modern Home Orthoptics

**T**HE Ortho-Fusor is primarily a home visual training device—one that can be prescribed by the doctor for the patient, to be used at home or any place that light and time are available. The Ortho-Fusor is not a complete course in Orthoptics. It is rather a necessary adjunct that provides an effective and efficient means for the patient to follow the visual exercises that have been prescribed. The method is simple, easy to explain, easy to understand, and easy to carry out. The Ortho-Fusor arouses patient interest that insures active cooperation.

Binocular vision, however faulty such vision may be, is an essential requirement for the effective use of the Ortho-Fusor. The purpose of this modern orthoptic device is to stimulate and train fusion, exercise convergence independent of the accommodative effort, create an elastic flexibility between accommodation and convergence, and to influence duction response at the near point while the visual adaptations are stereoscopically applied. The Ortho-Fusor is extremely effective in training the visual skills involved in depth perception.

### Orthoptics with Polarized Light

The Ortho-Fusor consists of a series of five training vectographs bound in loose-leaf form with abbreviated instruction pages, a special pair of Polaroid three dimension glasses, and a reference manual. These are designed to fit into a handy pocket-size container.

The glasses are of the shell type and are fitted with Polaroid lenses whose axes of polarization are at 45 and 135 degrees respectively.

The Ortho-Fusor vectographs are essentially photographic films coated on both sides with a special emulsion by means of which stereoscopically similar pictures are recorded on the two sides of the film. A smooth aluminum coating on the back of the film reflects the incident light rays so that the light reflected from the vectographs is polarized in the plane of the 45th meridian by one of the double exposure pictures on the film and in the plane of the 135th meridian by the other picture. Thus when these are viewed through the Polaroid glasses, each eye receives the light from only one picture, and when fused they are transformed into lifelike reproductions in which depth is added to height and width.

### Base In and Base Out Exercises

The stereoscopically similar pictures of each Ortho-Fusor vectograph have an almost endless number of corresponding object points with varying lateral separations. These varying separations represent differing degrees of convergence which are associated with a relatively constant accommodation. When these variously separated corresponding object points are consecutively fused, they constitute an increase or decrease in convergence.

When the individual corresponding object points are on the same side of the median plane as the eye that will receive their reflected polarized light, the relative convergence demanded to

fuse them constitutes abduction or a decrease of the normal convergence needed for the fixation distance. When, however, these corresponding object points are on opposite sides of the median plane, the visual axes must cross in front of the vectograph and abduction is demanded to fuse these points. (See page 10).

Ortho-Fusor vectographs are essentially binocular fixation cards so designed that they represent the equivalent of varying degrees of base in and base out prisms. Thus the Ortho-Fusor is an attention stimulating means for effectively giving base in or base out prism exercises.

As a general premise we may consider that a patient is receiving base out or converging prism exercises as they proceed from Ortho-Fusor Vectograph No. 1 to the highest convergence point in No. 5. Base in type of prism exercises are being given the patient if they start with the highest

convergence in Vectograph No. 5 and work in the direction of No. 1. In other words, from Ortho-Fusor Vectograph No. 1 to No. 5 there is a gradual increase in the required convergence, and a decreased convergence when proceeding from No. 5 to No. 1 Vectograph.

The Ortho-Fusor series is designed so that the Vectograph No. 1 demands abduction for the fusing of all but one of its corresponding object points. The Vectograph No. 2 demands less abduction but also an approximately equal amount of adduction. Vectograph No. 3 demands a very low amount of adduction but more adduction than required by No. 2. The No. 4 Vectograph is entirely on the adduction side where the convergence point is always between the vectograph. Vectograph No. 5 is also entirely on the adduction side but again of a higher degree of convergence than No. 4.

## When to Use

1. In all cases where prism exercises are indicated.
2. To improve fusion quality (precision and speed).
3. To improve depth perception or stereopsis.
4. To improve accommodative agility and precision.
5. To help the latent Hyperope adapt himself to his proper plus Rx.
6. To help the Presbyope adapt himself to his first pair of bifocals.

### Findings Which Indicate Need of Ortho-Fusor Training

1. High exophoria at near or far.
2. Esophoria at far or near.
3. Low accommodative amplitude not associated with Presbyopia or pathology.

## Ortho-Fusors

4. Poor stereopsis or depth perception.
5. Low near point of convergence.
6. Low ductions.
7. Imperfect fusion and poor reflex responses.
8. Inaccurate fixations.

### Symptoms Which Indicate Need of Ortho-Fusor Training

*(Assuming Patient Is Wearing Proper Rx)*

1. Headaches from reading or other near point work.
2. Drowsiness from reading.
3. Headaches from movies or riding.
4. Inability to find place on page when reading music or book.
5. "Doctor, I just can't wear these glasses."

## CHAPTER II

# Instructions for Patients

ALL patients' eyes should be examined and proper ophthalmic correction provided before Orthoptic exercises are prescribed. Care should be exercised by the examiner to fully instruct the patient in the technique of using the Ortho-Fusor.

Patients for whom Ortho-Fusor exercises are prescribed should be warned to read the introduction in the spiral bound book and pages 2 and 5 in the Reference Manual. The patients should then proceed in accordance with the doctor's instruction dependent upon whether it is desired to stimulate or inhibit convergence for an established fixation distance.

The following instructions are important for the patient taking Ortho-Fusor training:

1. All Ortho-Fusor training should be performed with the special Polaroid three dimension glasses supplied with set. These should be worn over glasses worn for reading. Bifocal patients should use their reading addition for maximum benefits of exercises.

2. Hold the Ortho-Fusor vectograph horizontal and so that its plane is perpendicular to the line of sight. If the vectograph is turned away from this prescribed position, it materially upsets the values and effectiveness of their purpose.

3. Good diffused illumination on the vectograph is important. Advise patients to turn their backs to light so that pictures are illuminated with light passing over patient's shoulder.

4. Each picture should appear single and sharp to the patient. If it does not, it should be moved backward and

forward until the doubling disappears.

5. Repeated reference should be made to the control objects found in each picture. These serve as a constant check on monocular suppression.

6. Advise the patient, whenever he has difficulty seeing singly, to apply the "pointer method" of establishing fusion. For Ortho-Fusor Vectographs No. 1 and No. 2 the pencil or pointer should be held behind the pictures and for No. 3, No. 4, and No. 5 it should be held in front of the picture. (Page 15).

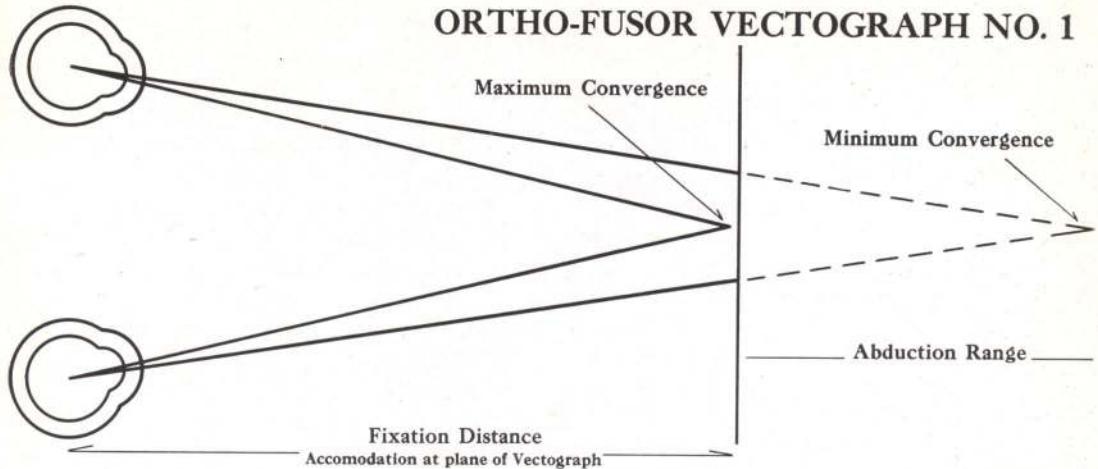
Instructing the patient to fix on a pencil held at the point where the object should appear will aid in promoting fusion. After training, the patient should be able to easily fuse all of the fixation points without the aid of the pencil.

Excellent hand and eye coordination training is accomplished by having the patient trace the outlines of these fixation objects that appear in space between the vectograph and the patient.

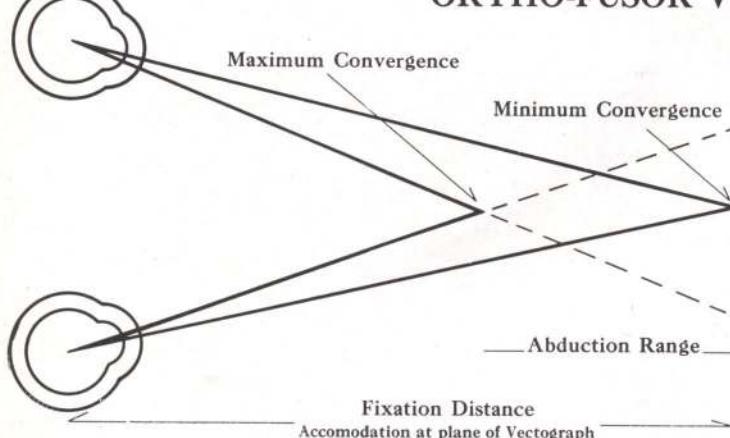
7. Patients should persist with each vectograph in the Ortho-Fusor set until they can accomplish all of the visual exercises with ease, speed, and precision. Continued repetition of the many saccadic exercises in each vectograph will develop the desired flexibility between accommodation and convergence that makes for visual comfort.

Patients have not accomplished the desired binocular reconditioning until they can readily perform the many visual tasks selected at random from any parts of the Ortho-Fusor set.

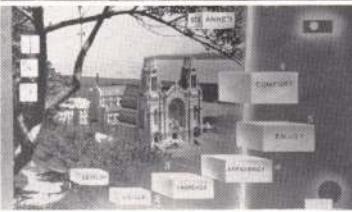
## ORTHO-FUSOR VECTOGRAPH NO. 1



## ORTHO-FUSOR VECTOGRAPH NO. 5



## ORTHO-FUSOR VECTOGRAPHS . . . 1st Edition



*Top row, from left to right:*  
 1. "Springtime", 2. "Navajo Weaver".  
*Second Row:*  
 3. "Boulder Dam", 4. "Saint Anne's",  
 5. "The Sierras".

## CHAPTER III

# Effective Prism Power

THE following tabulations are listed for the purpose of providing information concerning the extent and level of the convergence and duction requirements of each of the five Ortho-Fusor vectographs. The prism dioptral equivalents of convergence are given for a 60 millimeter pupillary distance. An eight per cent variation from these figures will give a close approximate for each 5 millimeter difference in pupillary distance. The effective prism equivalents under "Pursuit Type Exercises" and for ductions are constant for all pupillary distances.

*Saccadic type exercises* consist of repeated transfer of fixation from distant to near object points in any Ortho-Fusor vectograph, as it is held at any viewing distance. This procedure is similar to the step or jump type of prism exercise.

Because accommodation remains

fixed at the plane of the vectograph, the saccadic type exercises provide a sudden and effective change in the convergence associated with a fixed accommodation at the near point. This stimulation and relaxation of convergence independent of accommodation enables the patient to rapidly and positively establish the desired elasticity between accommodation and convergence.

*Pursuit type exercises* consist of maintaining fixation on certain points as suggested in the following tabulations and moving the Ortho-Fusor vectograph toward and away from the eyes. The continued change in fixation distance causes a change in accommodation, but due to the constant disparity between the fixation points the stimulated convergence changes at a different rate than the change in accommodation.

**ORTHO-FUSOR No. 1**  
*SACCADIC TYPE EXERCISE*

#### *PURSUIT TYPE EXERCISE*

Fixation Objects	Movement	Effective Prism
"E".....	6" to 26".....	4 <sup>△</sup> Base in
Front Row of Tulips.....	6" to 26".....	6 <sup>△</sup> Base in
Girl's Head.....	6" to 26".....	8 <sup>△</sup> Base in

## DUCTION EQUIVALENTS

Fixation Objects	Distance of Ortho-Fusor			Range of Pursuit Duction
	6"	13"	26"	
"R".....	○.....	○.....	○.....	○.....
"E".....	5 <sup>△</sup> Abd.....	2 <sup>△</sup> Abd.....	1 <sup>△</sup> Abd.....	4 <sup>△</sup> Abd.
Front Row of Tulips.....	8 <sup>△</sup> Abd.....	4 <sup>△</sup> Abd.....	2 <sup>△</sup> Abd.....	6 <sup>△</sup> Abd.
Girl's Head.....	10 <sup>△</sup> Abd.....	5 <sup>△</sup> Abd.....	2 <sup>△</sup> Abd.....	8 <sup>△</sup> Abd.

## ORTHO-FUSOR No. 2

### SACCADIC TYPE EXERCISE

<b>Distance of Ortho-Fusor</b>	<b>6"</b>	<b>13"</b>	<b>26"</b>
Minimum Convergence: Window at Rear	$35^\Delta$	$16^\Delta$	$8^\Delta$
Maximum Convergence: Numeral 17	$46^\Delta$	$21^\Delta$	$10^\Delta$
Convergence Range	$11^\Delta$	$5^\Delta$	$2^\Delta$
Total Range from 6" to 26"		$38^\Delta$	

### *PURSUIT TYPE EXERCISE*

Fixation Objects	Movement	Effective Prism
Window at Rear.....	6" to 26".....	4 <sup>△</sup> Base in
Numeral 18.....	6" to 26".....	3 <sup>△</sup> Base out
Numeral 17.....	6" to 26".....	5 <sup>△</sup> Base out

## DUCTION EQUIVALENTS

Fixation Objects	Distance of Ortho-Fusor	Range of Pursuit Duction		
	6"	13"	26"	
Window at Rear.....	5 <sup>△</sup> Abd.....	2 <sup>△</sup> Abd.....	1 <sup>△</sup> Abd.....	4 <sup>△</sup> Abd.
Numeral 18.....	4 <sup>△</sup> Add.....	2 <sup>△</sup> Add.....	1 <sup>△</sup> Add.....	3 <sup>△</sup> Add.
Numeral 17.....	6 <sup>△</sup> Add.....	3 <sup>△</sup> Add.....	1 <sup>△</sup> Add.....	5 <sup>△</sup> Add.

### ORTHO-FUSOR No. 3

#### SACCADIC TYPE EXERCISE

### *PURSUIT TYPE EXERCISE*

<b>Fixation Objects</b>	<b>Movement</b>	<b>Effective Prism</b>
Numeral 5.....	6" to 26".....	3 <sup>△</sup> Base out
Numeral 11.....	6" to 26".....	7 <sup>△</sup> Base out
Numeral 12.....	6" to 26".....	7 <sup>△</sup> Base out
Cube marked NEV.....	6" to 26".....	8 <sup>△</sup> Base out

## DUCTION EQUIVALENTS

Fixation Objects	Distance of Ortho-Fusor	Range of Pursuit Duction		
	6"	13"	26"	
No. 3 Streamer End.....	2 <sup>△</sup> Abd.....	1 <sup>△</sup> Abd.....	1 <sup>△</sup> Abd.....	2 <sup>△</sup> Abd.
No. 5 Streamer End.....	4 <sup>△</sup> Add.....	2 <sup>△</sup> Add.....	1 <sup>△</sup> Add.....	3 <sup>△</sup> Add.
No. 11 Streamer End....	9 <sup>△</sup> Add.....	4 <sup>△</sup> Add.....	2 <sup>△</sup> Add.....	7 <sup>△</sup> Add.
No. 12 Streamer End....	9 <sup>△</sup> Add.....	4 <sup>△</sup> Add.....	2 <sup>△</sup> Add.....	7 <sup>△</sup> Add.
Cube Marked NEV.....	10 <sup>△</sup> Add.....	5 <sup>△</sup> Add.....	2 <sup>△</sup> Add.....	8 <sup>△</sup> Add.

**ORTHO-FUSOR No. 4**  
**SACCADIC TYPE EXERCISE**

<b>Distance of Ortho-Fusor</b> .....	<b>6"</b>	<b>13"</b>	<b>26"</b>
Minimum Convergence: River Bank.....	40 <sup>△</sup>	18 <sup>△</sup>	9 <sup>△</sup>
Maximum Convergence: Cube 6.....	54 <sup>△</sup>	24 <sup>△</sup>	12 <sup>△</sup>
Convergence Range.....	14 <sup>△</sup>	6 <sup>△</sup>	3 <sup>△</sup>
Total Range from 6" to 26".....			45 <sup>△</sup>

**PURSUIT TYPE EXERCISE**

<b>Fixation Objects</b>	<b>Movement</b>	<b>Effective Prism</b>
No. 1 "Develop".....	6" to 26"	3 <sup>△</sup> Base out
No. 3 "Increase".....	6" to 26"	5 <sup>△</sup> Base out
No. 6 "Comfort".....	6" to 26"	11 <sup>△</sup> Base out

**DUCTION EQUIVALENTS**

<b>Fixation Objects</b>	<b>Distance of Ortho-Fusor</b>	<b>Range of Pursuit Duction</b>
Cathedral Corner.....	6"	13"
No. 1 "Develop".....	3 <sup>△</sup> Add.	2 <sup>△</sup> Add.
No. 3 "Increase".....	7 <sup>△</sup> Add.	3 <sup>△</sup> Add.
No. 6 "Comfort".....	14 <sup>△</sup> Add.	6 <sup>△</sup> Add.
		1 <sup>△</sup> Add.
		3 <sup>△</sup> Add.
		11 <sup>△</sup> Add.

**ORTHO-FUSOR No. 5**

**SACCADIC TYPE EXERCISE**

<b>Distance of Ortho-Fusor</b> .....	<b>6"</b>	<b>13"</b>	<b>26"</b>
Minimum Convergence: Square I.....	45 <sup>△</sup>	20 <sup>△</sup>	10 <sup>△</sup>
Maximum Convergence: Square II.....	60 <sup>△</sup>	27 <sup>△</sup>	14 <sup>△</sup>
Convergence Range.....	15 <sup>△</sup>	7 <sup>△</sup>	3 <sup>△</sup>
Total Range from 6" to 26".....			50 <sup>△</sup>

**PURSUIT TYPE EXERCISE**

<b>Fixation Objects</b>	<b>Movement</b>	<b>Effective Prism</b>
Numeral 1.....	6" to 26"	4 <sup>△</sup> Base out
Numeral 3.....	6" to 26"	5 <sup>△</sup> Base out
Numeral 7.....	6" to 26"	10 <sup>△</sup> Base out
Numeral 11.....	6" to 26"	15 <sup>△</sup> Base out

**DUCTION EQUIVALENTS**

<b>Fixation Objects</b>	<b>Distance of Ortho-Fusor</b>	<b>Range of Pursuit Duction</b>
Numeral 1.....	5 <sup>△</sup> Add.	2 <sup>△</sup> Add.
Numeral 3.....	6 <sup>△</sup> Add.	3 <sup>△</sup> Add.
Numeral 7.....	12 <sup>△</sup> Add.	6 <sup>△</sup> Add.
Numeral 11.....	19 <sup>△</sup> Add.	8 <sup>△</sup> Add.
		4 <sup>△</sup> Add.
		15 <sup>△</sup> Add.

*It must be borne in mind that these tabulations are listed to provide information to the examiner concerning the progress being made by the patient and to illustrate the range of convergence, effective prism, and ductions incorporated in each of the Ortho-Fusor vectographs.*

# Training Suggestions

**T**o check the existence of any monocular suppression, call the patient's attention to the three white squares in the lower left corner of the Ortho-Fusor Vectograph No. 1. Determine whether the black square and black circle are simultaneously seen in the center of their respective white squares. In case the patient sees only one of these control objects, it is evidence that he is suppressing, and may be termed a monocular adapter at the reading distance. If the patient indicates that he sees the square and circle alternately, it is evident that he has a tendency toward alternate fixation or alternate monocular adaptation at the reading distance.

If the patient declares that he sees both the black circle and square simultaneously, he should next be asked whether he sees both the horizontal and vertical black lines of the No. 3 control object, and to indicate whether and where they cross each other. If the vertical black line shifts toward the left of the center of the horizontal black line, it represents esophoria. The vectograph should be moved farther away from the patient to reduce the accommodative demand. If the vertical line continues to appear to the left of the center of the horizontal line, the patient's Ortho-Fusor exercises should begin with either Vectograph No. 3, No. 4, or No. 5 depending upon the degree of the esophoria. In this case the patient should be advised to apply a program of exercises that proceeds toward accomplishing the fusion demands of the next lower numbered Ortho-Fusor vectograph. If on the other hand the

vertical black lines seem to be shifted toward the right of the center of the horizontal black line, exophoric tendency is manifested, and in this case the Ortho-Fusor should be moved closer to the patient to establish, if possible, a centering of the crossing of the lines. For this latter case the exercises should start with Ortho-Fusor Vectograph No. 1 by selecting a more widely separated pair of corresponding object points with the Ortho-Fusor held approximately six inches in front of the patient's eyes.

## Fixation Aid for Convergence

In case the patient is unable to fuse any of the corresponding points, regardless of the fixation distance, an effective procedure consists of having the patient hold a pencil or small pointer in vertical position behind the Ortho-Fusor vectograph in the case of exophoria and in front of it for esophoria. The patient should be advised to hold the pencil or pointer so that its point will appear half way between the corresponding object points selected. Starting with the pencil close to the card, the patient is advised to rivet his attention on the point of the pencil while he is slowly moving it away from the card. He should be advised at the outset to note that he sees the corresponding object point on both sides of the pencil point and that he should not lose sight of these as he moves the pencil away from the picture. When the pencil reaches the position which aligns it, for each eye, with the respective corresponding points, fusion of them should be established.



ABOVE: When patients have difficulty seeing Ortho-Fusor Vectograph No. 1 and 2 singly, the "pointer method" is a most effective aid in establishing fusion. In this training the pointer should be held behind as shown above.

BELLOW: If patients do not promptly fuse the fixation points in Ortho-Fusor Vectographs No. 3, 4 and 5, a pointer held in front and in line with these fixation objects will aid in the early training of convergence.



When fusion of any pair of corresponding object points is achieved, the Ortho-Fusor should be gradually moved toward the normal reading distance while the patient continues to fuse these points (the tulip E, I, or U, the girl's head, or the tip of the flare projected from "Springtime"). With fusion established for any given object points, the patient is asked whether he senses, in this instance, that the object viewed appears to be at a greater distance than the Ortho-Fusor vectograph he is holding. After this is accomplished, the patient is directed to move the Ortho-Fusor first toward and then away from his eyes. This is repeated several times without changing the patient's observation point.

For the next step we suggest advising the patient to direct his attention to any selected object points when the Ortho-Fusor is at arm's length and proceeding as before by moving it toward his eyes. This procedure should be continued until all of the object points in Vectograph No. 1 can be fused and projected to their relative spacial position. Before this patient should be allowed to undertake Vectograph No. 2, he should be instructed to proceed with the development of the visual skills demanded when all points in the training vectograph are consecutively fused and projected. As the patient advances from the No. 1 to Ortho-Fusor Vectograph No. 2, he should be instructed to follow the same routine applied to No. 1.

This general routine is also applied to the esophoric patients with but one exception. This exception consists of starting with the Ortho-Fusor Vectograph No. 5 and proceeding from its greatest separation points toward the least and then following these consecutively with those of No. 4, No. 3, No. 2, and No. 1.

The foregoing sounds like a long procedure, but it is surprising how little time is required for the examiner to establish the type of program required by the patient and to instruct the patient how to apply it. Since the patient should do these exercises at home, the time which the examiner must apply to these cases is limited to determining the type of exercises required and that consumed at the various times when progress is demonstrated by the patient.

It is interesting to note how rapidly the average patient will progress and how most of the tediousness of secondary Orthoptic procedures is therefore eliminated.

In all cases it is advisable to make an analysis of the patient's visual condition at each time when satisfactory progress is demonstrated by the patient so that the advised changes in the patient's correction can be made to speed his accomplishments for visual comfort and efficiency.

### Control Tests

Whenever advancing the patient from one Ortho-Fusor vectograph to another, the examiner should check the control object accomplishment to make certain there is no suppression and that fusion is positive and rapid. These are as follows:

No. 2—The encircled numbers 14 and 20.

No. 3—The vertical and horizontal black lines in the white squares marked "A." (This vectograph also provides check objects numbered 9, 10, 11, and 12 to be used when the accomplishment of all corresponding object points of the Boulder Dam picture have been achieved.

No. 4—The three squares on the left-hand margin.

No. 5—Squares No. 1, No. 2, and No. 3.

## Depth Perception Tests

As a final check on stereoscopic accomplishment, the patient's attention should be directed to the titles "Navajo Weaver" on picture No. 2 and "Nevada Side," "Boulder Dam," and "From Arizona Side" on picture No. 3. The letters "O" and "W" of the "Navajo Weaver" title should appear closest, the letters "N" and "R" farthest from the observer, with the other letters so placed that the entire title seems to be suspended in air with the center close to and the extremities farther from the observer. In the case of the pointer entitled "Nevada Side," the first letter of each of these words should appear nearer to and each subsequent letter farther from the observer. The title "Boulder Dam" should appear as though its letters were suspended in air with the "B" nearest and the "M" farthest away, thus sloping from left to right toward the picture. The title "From Arizona Side" is the reverse of "Boulder Dam" in that it slopes from right to left toward the picture.

## Hand and Eye Coordination

In order to stimulate greater interest and credit for having accomplished the visual skills demanded by the Ortho-Fusor, have the patient point with pencil or pointer to the aerial position apparently occupied by the various objects in Vectographs No. 3, No. 4, and No. 5 and by outlining these objects in their spacial position. This coordination of hand and eyes is an excellent training exercise which is particularly dramatic and effective.

## Pursuit Type Exercises

Regardless of whether abduction or adduction (base in or base out exer-

cises) are being developed, the extent of the demands incident to the accomplishment of these responses are amplified by moving the Ortho-Fusor closer to the patient and decreased by moving it away. This act of moving the Ortho-Fusor establishes different degrees of duction demands at different levels of convergence stimulation, which reflexly results from the variation in the accommodative responses for the different distances of the Ortho-Fusor. The "pursuit" type of exercise provides opportunity for a very gradual increase or decrease in the accomplishment demands and by alternately moving the Ortho-Fusor back and forth, the normal elasticity between accommodative and convergence is re-established.

A combination of "pursuit" and "saccadic" training may be applied by having the patient fuse one of the corresponding object pairs with short separation distance while the Ortho-Fusor is held at arm's length. While the patient continues to fuse these points, have him move the Ortho-Fusor slowly toward himself through approximately six inches and at this point, without stopping the "pursuit" stimulation, have the patient direct his attention to another pair of corresponding object points with a little wider separation. Repeat this each time at each six-inch interval until the Ortho-Fusor has been brought to the nearest point of fusion accomplishment. When diplopia results, even though only temporary, have the patient start the procedure again from arm's length distance.

Perseverance is required to master the Ortho-Fusor training set; the reward is greater visual comfort as well as greater visual skill.



