Measuring aniseikonia with the telebinocular

Donald L. Salmon
Pacific University

Benjamin J. Kister
Pacific University

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Measuring aniseikonia with the telebinocular

Abstract
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MEASURING ANISEIKONIA WITH THE TELEBINOCULAR

Presented to the Faculty of the College of Optometry at Pacific University

In Partial Fulfillment of Requirements for the Degree of Doctor of Optometry

Submitted by:

Donald L. Salmon
Benjamin J. Kister

May 1976
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We owe a considerable debt of gratitude to Dr. Robert E. Bannom, Secretary of Aniseikonia Forum, for fundamental orientation and timely advice during this study.

We thank the Oregon Optometric Association and the College of Optometry at Pacific University for contributing a share of the funds required to conduct the study.

We also express appreciation to the Mast-Keystone Company who loaned us a current model of the telebinocular needed to carry out the work.

Finally, we acknowledge the inspiration of Dr. Oscar Richards of Pacific University who imbued us with a rich sense of history and an insight into the memorable personalities, including his own, who deck the canvasses in the gallery of aniseikonia.

D.L.S.

B.J.K.
Accepted by the faculty of the College of Optometry, Pacific University, in partial fulfillment of the requirements for the Doctor of Optometry degree.

William M. Ludlam, O.D.
Thesis Advisor

Niles Roth
Chairman of Thesis
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>2</td>
</tr>
<tr>
<td>Purpose</td>
<td>2</td>
</tr>
<tr>
<td>History</td>
<td>2</td>
</tr>
<tr>
<td>A Review of Other Measuring and Screening Instruments</td>
<td>5</td>
</tr>
<tr>
<td>General Plan of the Present Study</td>
<td>9</td>
</tr>
<tr>
<td>Apparatus</td>
<td>10</td>
</tr>
<tr>
<td>Table I - Specifications of Size Lenses</td>
<td>13</td>
</tr>
<tr>
<td>Procedure</td>
<td>14</td>
</tr>
<tr>
<td>Table II - List of Induced Aniseikonia Values</td>
<td>17</td>
</tr>
<tr>
<td>Results</td>
<td>18</td>
</tr>
<tr>
<td>Conclusions and Discussion</td>
<td>19</td>
</tr>
<tr>
<td>References</td>
<td>22</td>
</tr>
<tr>
<td>Appendix I - Raw Data</td>
<td>24</td>
</tr>
</tbody>
</table>
INTRODUCTION

"Aniseikonia, as a subject, resembles one of Britain's less frequented railway lines - a by-way, which, although its lines have not yet been torn up by some iconoclastic optical Beeching, yet sprouts the weeds of relative disuse. But it has its own quaint elegance, and is even occasionally useful." So stated K. A. Harwood (1), in a lecture delivered to the Orthoptic Association at the London Refraction Hospital in 1965.

In the authors' view, this statement aptly describes the importance placed on Aniseikonia in the minds and practices of most of today's Optometrists. This seems like a curious paradox when, as declared by Bannon (2), "There is hardly any other subject in the field of refraction that has been developed with greater care and supported by more extensive research than that of aniseikonia."

The late Hermann Burian (2) in 1970 asked, "Why is there not more interest in the measurement and correction of aniseikonia? Inertia? A need for simpler instrumentation? Because the examination is difficult? Because the lenses are too complicated? Is the economic yield unsatisfactory?" Burian felt that all these factors played their part. However, he concluded his remarks to the Optometric Academy in that year, 1970, in saying, "It is the responsibility of the ophthalmic professions to provide for the availability of this (aniseikonia) service."
INSTRUMENTATION

Apparently due to lack of interest and demand, manufacturers of ophthalmic instruments in the United States no longer manufacture apparatus for the practitioner to measure aniseikonia.

The American Optical company discontinued production and distribution of the office model Space Eikonometer in 1966, after having sold no more than 300 of these instruments (3), which had come to be accepted as the 'standard' of measurement in the field of aniseikonia.

The Mast-Keystone company has also discontinued production of the Orthoscope, a specially designed, distortion-free stereoscope, intended to be used with Eikonograms - a set of stereo cards prepared to measure all variables of aniseikonia.

Thus, the situation currently faced by the practitioner who is interested in the measurement of aniseikonia, is the virtual unavailability of any commercially manufactured instrument for that purpose.

PURPOSE

This dissertation intends to report on the feasibility of adapting the Ophthalmic Telebinocular, a widely used stereoscope, manufactured and distributed by the Mast-Keystone Company.

HISTORY

It was in 1938 that Lancaster (4) coined the term 'Aniseikonia', meaning an inequality in the size or shape of the image in each eye under binocular conditions.
However, as early as 1864 Donders (5) discussed the difference in retinal image size resulting from the correction of anisometropia with spectacles.

In any case, it was not until after World War I that the organized study of aniseikonia began, under the leadership of Adelbert Ames. In 1919 Ames arrived at Dartmouth College and, with Charles Proctor, professor of physics, began the studies which ultimately led to the development of the methods for the measurement and correction of aniseikonia (2). Ames became the founder and guiding spirit of the Dartmouth Eye Institute, where he assembled a noteworthy group of visual scientists. Here, over a fifteen-year period (1932-1947), the Dartmouth Eye Institute functioned both as a research center and a clinic. The Rockefeller Foundation Fund contributed a great deal to the support of this research work. The American Optical Company was also a key factor, both in the financial support of the Institute as well as in contributing the efforts of some of its most talented personnel, and by making available its instrument and lens manufacturing facilities. The efforts of the people at the Dartmouth Eye Institute and the American Optical Company conjointly resulted in the development of instrumentation for the measurement of aniseikonia, most notably the Space Eikonometer. At the same time techniques, clinical skill and manufacturing experience were developed with respect to the aniseikonic examination, the art and science of prescribing optical correction and the production of corrective, or iseikonic lenses.
The work of the Dartmouth group provided more than a hundred technical and clinical papers, which appeared in various professional journals.

Ogle's scholarly book "Researches in Binocular Vision" presents an excellent account of the factual and theoretical aspects which led to the development of the Space Eikonometer (6).

Since the work of the Dartmouth Institute came to an end in 1947, active general interest in the field of aniseikonia appears to have declined considerably. However, here and there a bright flame of concern still flourishes, in the work of some dedicated ophthalmic practitioner and in the publications and efforts of certain individuals, both in this country and abroad.

In this country most notably is Robert E. Bannon of the American Optical Company and Secretary of the Aniseikonia Forum, who continues to offer his counsel to those interested. The efforts and publications of Arthur Links (7) have done much to engender a deeper understanding of the subject and an awareness of its importance.

In Great Britain, Gillot (8) and Harwood (1) pressed for the eikonometric examination as an adjunct to orthoptlc procedures, where image size differences in the eye might constitute an obstacle to fusion and consequently the efficacy of orthoptic treatment.

In Japan, Hosaka (9) highlighted the importance of aniseikonia in a study of 166 asthenopic patients in whom he found greater amounts of aniseikonia, compared to a control group of 140 non-asthenopic subjects.
In the Soviet Union, Kogan (10) examined 131 patients, who complained of impaired vision and eyestrain, for aniseikonia. He found that 81.6% of this group had clinically significant amounts of aniseikonia. He concluded that aniseikonia should be considered an important causative factor in binocular difficulties.

A REVIEW OF OTHER MEASURING AND SCREENING INSTRUMENTS

The Space Eikonometer, once manufactured by the American Optical Company, still holds the unique 'emeritus' chair among the instruments that have been developed for the measurement of aniseikonia. Nevertheless, quite a number of other instruments and techniques have been constructed, possibly because of the unavailability of an accurate, simple, inexpensive, qualitative and quantitative technique for the detection and measurement of aniseikonia.

Allen (11), for example, described a simple clinical test using central fixation and fusion; instrumentation consisted of a stereoscope, a special stereocard, rotary prisms and size lenses.

Brecher (12) in 1951 utilized diplopia to measure aniseikonia, using muscle lights, a Maddox rod placed before one eye and a set of size lenses. However, only measurements in the horizontal meridian were possible.

In 1952, Lord Charnwood (13) of Great Britain devised a set of specially designed stereocards, similar to the images to be seen in the Space Eikonometer, to measure 2% axis 90, 4% axis 90, 15° declination and 45° declination aniseikonias. These cards were published by the Hatton Press, but they are no longer available.
Malin (14), in 1955, built his own Space Eikonometer. His instrument consisted of a black background plus a few colored cords, frames, and a wooden aperature, which were hung from appropriate hooks in the ceiling of the examining room when required. Malin had some merdional size lenses placed in a discarded Stevens Phorometer to measure declination, while size lenses were used according to the modified technique suggested by Fisher (15) to measure overall and meridional aniseikonia. While this method may suffer from the inconvenience of setting up the apparatus when the test is required, the authors of this dissertation recommend a consideration of replicating Malin's device by any optometrist seriously interested in the measurement and correction of aniseikonia. This instrument permits accurate measurement to be made and therefore is as useful as the office model Space Eikonometer, though admittedly less convenient to use.

Cohen, Forman, and Milan (16) in 1957 made a set of twenty-one stereo slides by photographing a model of the original space eikonometer. These slides were used in a stereoscope - the Stereo Realist Viewer Model ST62-56 - to measure aniseikonia induced in varying amounts, by the use of size lenses. Examination results showed that for values between 0.00% and 4.00% magnification, axis 90 and axis 180, of induced aniseikonia, measurements taken with the screening slides could be taken to an accuracy of ± 0.50%, compared to measurements obtained with the Space Eikonometer.

It was the success of Cohen, Milan and Forman, in using a commercially available stereoscope which suggested to the present authors that it might be feasible to use the Mast-Keystone Telebinocular. In
1958 the Keystone View Company (17) developed a carefully made set of graded stereograms, which they called eikonograms. These were to be used with an accompanying instrument, the orthoscope - a special stereoscope designed to be relatively distortion free. It was constructed with cells placed at very well defined distances from the eye. The cells were meant to accept low power spherical and cylindrical lenses in order to change magnification by prescribed amounts before one or both eyes. For a while, this instrument was the only one made on a production basis available for professional use. But recently, the Mast-Keystone company decided to discontinue manufacture of the orthoscope, due to low demand and high manufacturing costs. The eikonograms are, however, still available, though they would require the creation or modification of another stereoscope and diagnostic procedure, if they are to be again useful for the measurement of aniseikonia.

Ludlam and Fisher (18) sought a method of measuring aniseikonia in strabismic patients for whom the lack of stereopsis made testing with the space eikonometer impossible. Their procedure made use of a Xenon flash tube to imprint a strong after-image on the retina of one eye. This eye is then occluded and the other eye is used to adjust projected index marks of variable separation to match the patient's subjective perception of the apparent separation of the 'transferred' after-images, seen upon a screen located in the plane of the flash tube. The measured separation of the matching index marks then provides some measure of the relative size of the ocular images. Using this approach, the authors were able to determine the type and amount of aniseikonia within 2% horizontally and 1% vertically.
One screening device that is presently procurable from the American Optical Company (19) is a polaroid Vectographic Near-Point Card. The device in question is known as Vectographic Near-Point Card No. 4. It is built to be used with an American Optical Company Phoropter and is intended for use in the screening or detection of differences in meridional or overall retinal image size. In fact, the device is an adaptation of the Standard Eikonometer, fabricated in the form of a near-point card. The instruction booklet says that, "A determination of the magnitude of an indicated or overall aniseikonia may be made by eliciting from the patient an estimate of the vernier displacement in terms of limb line thickness. A displacement equivalent to one line width of the inner limbs is equivalent to one percent size difference." The authors of the present dissertation requested, but did not receive, from the Company, any experimental or clinical research information relating to the dependability of this device in clinical use.

Finally, Hawkswell (20), most recently, in 1974, reports an analysis of data obtained after screening 1,000 cases for aniseikonia. The author states, "Previous attempts to assess the incidence of aniseikonia by means of large scale eikonometry were hampered by the bulk or complexity of those instruments which were available."

"In view of the encouraging results obtained with a simplified eikonometer which will be described in a subsequent paper, 1,000 measurable patients attending the eye department of a general hospital consecutively were examined with the instrument."

The 'subsequent paper' alluded to above has not yet appeared, at the time of writing. Meanwhile, the authors have initiated corres-
pondence with Dr. Hawkswell in the hope of obtaining advance informa-
tion which will be included as an appendix to this dissertation, if
it is available in time.

It is of interest to mention Hawkswell's conclusion, to wit:
"Since it was concluded that the incidence of (significant*) anis-
eikonia was as high as 9 percent and that empirical estimation was
unreliable, it would be desirable to include eikonometry into the
clinical refraction routine."

GENERAL PLAN OF THE PRESENT STUDY

This study employed a current Model Telebinocular, three
Eikonograms and a set of size lenses to measure induced aniseikonia
with the Telebinocular. Parallel measurements were also taken with
the A.O. Space Eikonometer, so that the measurements taken by the
two different methods could be compared. The objective was to see
how accurate the Telebinocular measurements could be. The Space
Eikonometer readings were considered as the 'standard' of comparison.

Comparable measurements were taken on thirty 'clinical' subjects.
To ensure that a sufficient aniseikonic range was tested, ten combina-
tions of level and type of aniseikonia were induced in the subjects.
Three subjects were thus tested for each sort of induced aniseikonia.

A number of recommendations were made for using the telebinocular
for this purpose, and to the manufacturer for improvements which would
likely increase the precision of measurement possible with the instru-
ment.

*Authors emphasis and interpretation.
APPARATUS

The apparatus consisted of the following elements:

1. A contemporary model Ophthalmic Telebinocular, supplied by the Mast-Keystone Company. This instrument has a fixed p.d. The eye-piece consists of two +5.00 D spheroprisms which are not corrected to produce a distortion-free field.

   This instrument is widely used in the ophthalmic professions for a variety of purposes. It is expected that its manufacture and distribution will be continued at a reasonable cost. Therefore it was felt that this effort to adapt the instrument for use in aniseikonia measurement would be worthwhile.

2. Stero-eikonogram card No.1, taken from the set of thirty eikonogram targets, manufactured by the Mast-Keystone Company. This eikonogram is the "plano" or iseikonic stereogram of the set. It reflects no aniseikonic distortion. Its proportions parallel the image which would be seen in the space eikonometer with all controls set at 0.

   The authors had the option of using either this one eikonogram or the full set of fifteen cards. The use of one card only was opted for, with respect to measurements of overall and meridional aniseikonia, for several reasons. First, the tolerances to which such cards must first be printed and subsequently maintained are very small - fractions of a millimeter - in order to realize accurate measurements. Discussions with Dr. Oscar Richards, of Pacific University, and our own experience in manipulating these cards, convinced us that the stiff cardboard on which the eikonograms are mounted for insertion in the instrument, is a material which is vulnerable to changes in dimension.
as a result of constant use as well as from temperature and moisture changes in the environment over periods of time. We therefore concluded that were our experimental results to show the feasibility of using the telebinocular for purposes of aniseikonia, then one thing that would be needed, in the future, would be a durable and accurate manufactured iseikonic stereogram fabricated with glass or plastic backing for constant, dependable use. The production of one such card appeared, to us, potentially easier and less costly in the future, as opposed to fifteen such stereograms. A further reason for opting for one stereocard only, is that we felt the use of eikonograms, in the full set, is a laborious and complex procedure. Furthermore, even the use of the full set nevertheless requires the conjunctive use of lenses to produce some magnification changes - the eikonograms alone are insufficient because there is a difference of 2% aniseikonia between each card. The use of the now obsolete orthoscope with the cards called for the use of small spherical and astigmatic power lenses, presumably meant by the manufacturer to obviate the need for the practitioner to purchase a set of afocal size lenses. In retrospect, this was likely to have been an unsound procedure. Dr. Robert Bannon (21) has called to our attention the research of Peters (22) which showed that as little as 0.12 D of induced anisometropia can cause a measurable decrease in sterosensitivity. Sterosensitivity is the very foundation of aniseikonia measurement with the Mast-Keystone (as well as most other) instrumentation for the measurement of aniseikonia.
The above factors pointed to the conclusion that with the Mast-Keystone Eikonograms, the use of size lenses rather than power lenses was highly desirable.

Once the need for a set of size lenses was accepted, then the use of a full set of the eikonograms offered no advantage over the one iseikonic stereogram.

3. Two eikonogram cards were used only for declination estimates. These were eikonograms No.'s. 14, 15, 29, and 30 which are designed to measure declinations of -0.8°, -0.4°, +0.8°, and +0.4° respectively.

4. Two sets of afocal size lenses, used both to induce and measure aniseikonia with the modified instrument. Since a complete set of size lenses was not available, the authors designed their own and arranged to have them fabricated by a local optical laboratory.

Both overall and meridional lenses were used. Table I is a presentation of the specifications of these lenses.

Due to the inability of the local supplier, Opti-Craft, Inc., to manufacture a full range of the meridional lenses ordered, only a limited number of such lenses were available to the authors to induce or measure aniseikonia: namely 0.25%, 0.50%, 1.50% and 2.50% meridional lenses.

Due to the unusual difficulty of equipment modification and also due to the unavailability of meridional lenses required, declination errors were not induced in the subjects. However, the declination eikonograms #14, #15, #29 and #30 were used to attempt broad classification of any declination error present in a subject, without its being induced.


<table>
<thead>
<tr>
<th>% Mag.</th>
<th>Overall Magnification</th>
<th>Meridional Magnification</th>
<th>Center Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Front Curve*</td>
<td>Back Curve#</td>
<td>Front Curves</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M1</td>
</tr>
<tr>
<td>0.25</td>
<td>+1.08</td>
<td>-1.12</td>
<td>plano</td>
</tr>
<tr>
<td>0.50</td>
<td>+2.40</td>
<td>-2.50</td>
<td>plano</td>
</tr>
<tr>
<td>1.00</td>
<td>+6.43</td>
<td>-6.50</td>
<td>plano</td>
</tr>
<tr>
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</tr>
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<td>plano</td>
</tr>
<tr>
<td>2.50</td>
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</tr>
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</tr>
<tr>
<td>3.50</td>
<td>+11.96</td>
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</tr>
<tr>
<td>4.00</td>
<td>+11.96</td>
<td>-12.50</td>
<td>plano</td>
</tr>
</tbody>
</table>

* The nominal values of these front curves are +1.25, +2.50, +6.50, +6.50, +7.50, +7.50, +11.50, +12.50, +12.50 respectively. The values given in the Table are the readings that would be found with a diop- tometer, calibrated for n = 1.53. These values are called 'true values' by the optical laboratory.

# True values, i.e. dioptometer values based on n = 1.53. These are fabricated to the nearest 0.12 diopter for manufacturing reasons.
PROCEDURE

1. Basic procedure involved taking aniseikonia measurements:
(a) With the AO Space Eikonometer, as a 'standard'
(b) Through the Telebinocular, with stereo-eikonogram No.1 placed at the far point of the instrument. In this case measurements were taken by means of size lenses placed in the lens holders which form part of the instrument (see Fig.1). Before use, this optical system was checked to ensure that no aniseikonia was present by virtue of the optical system itself.

Figure 1
The modified Telebinocular-Iseikonogram used with Size Lenses.
2. Each subject was carefully placed in the instrument to ensure no vignetting of the elements in the eikonogram. Questions were posed to the subjects to see if stereopsis was experienced and that the lines and cross of the target were perceived in their expected positions.

Measurements of overall and meridional aniseikonia were taken. In the case of measurements taken with the Telebinocular, overall magnifiers instead of meridional magnifiers were used in creating and measuring size differences in the horizontal meridian so as not to induce tilting of the cross; in this way making judgments easier for the subject. This is the modified procedure for space eikonometry recommended by Fisher (15).

3. In this study very precise measurements of declination were not attempted. This would have required greater modification of the Telebinocular. However, estimates of declination were taken by use of the four special declination eikonograms, numbers 14, 15, 29 and 30. By introducing these cards at the far point of the Telebinocular, after the measures of overall and meridional aniseikonia at 90 and 180 degrees had been taken, declination measures were taken, where required. These measures allowed us to classify the declination into one of the following groups.

<table>
<thead>
<tr>
<th>NEGATIVE</th>
<th>POSITIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Less than $-0.4^\circ$</td>
<td>Less than $+0.4^\circ$</td>
</tr>
<tr>
<td>2. More than $-0.4^\circ$ but less than $-0.8^\circ$</td>
<td>More than $+0.4^\circ$ but less than $+0.8^\circ$</td>
</tr>
<tr>
<td>3. More than $0.8^\circ$</td>
<td>More than $+0.8^\circ$</td>
</tr>
</tbody>
</table>
4. The subjects included in the study were: thirty subjects drawn primarily, though not exclusively, from the student group at the Pacific University College of Optometry. These were all "unsophisticated" subjects in the sense that none had had any significant previous experience in being measured for aniseikonia. This was felt desirable due to the clinical orientation we wished to give to the study.

For each of the subjects, a given amount of overall or meridional aniseikonia was first induced by placing either an overall or meridional size lens over the left eye in a Halberg Clip, for those who already wore a distance spectacle correction. The eyewire distance of the size lenses was 5 mm. from the front surface of the subject's spectacles, when placed in the Halberg Clips. For those wearing no spectacle correction or contact lenses, the aniseikonic lenses were placed in a trial frame. In all cases a plano lens with no magnification was placed over the right eye to ensure that illumination was balanced between the two eyes.

As we desired to test the 'instrument' over a range of possible aniseikonic levels, a different single type and amount of induced aniseikonia was introduced in different individual subjects. For each aniseikonic 'value' induced, this amount was applied to three subjects, so that each separate value was represented thrice in the study.

A modified ABBA technique was used to keep practice effects to a minimum, the subject being measured first on one instrument, and then on the other for any given size difference. Table II presents a list
of the various types and levels induced, each one in three subjects.

<table>
<thead>
<tr>
<th>TABLE II</th>
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<tbody>
<tr>
<td>List of Induced Aniseikonia Values</td>
</tr>
<tr>
<td>0.50% O.A.</td>
</tr>
<tr>
<td>1.00% O.A.</td>
</tr>
<tr>
<td>2.00% O.A.</td>
</tr>
<tr>
<td>3.00% O.A.</td>
</tr>
<tr>
<td>0.50% x 180</td>
</tr>
<tr>
<td>1.50% x 180</td>
</tr>
<tr>
<td>2.50% x 180</td>
</tr>
<tr>
<td>0.50% x 90</td>
</tr>
<tr>
<td>1.50% x 90</td>
</tr>
<tr>
<td>2.50% x 90</td>
</tr>
</tbody>
</table>

The method of limits was used for obtaining the measurements of aniseikonia, in each case, and for determining the subject's level of sensitivity. In the Telebinocular, all measurements were taken by means of changes in size lenses placed in one of the lens holders of the instrument, and/or by using one of the four declination eikono-grams.

For each presentation of the target, on one of the two instruments, the subject was asked to make three observations:

1. Which of the two front lines was closer, if any?
2. Which of the two sides of the cross was closer, if any?
3. Which of either the top or bottom of the cross was closer, if any.
The p.d. of each patient was also noted in preparation for an analysis of this factor's possible relationship to the accuracy of measurements taken with the Telebinocular.

RESULTS

Data were obtained comparing results of measurements between the Space Eikonometer and the Telebinocular for the horizontal and vertical meridians separately. Means, standard deviations and "t" scores were computed to compare the readings taken in each instrument.

Using the Space Eikonometer as a standard, the mean difference in measurements of magnification taken with the Telebinocular, in the horizontal meridian was 0.14%, with a standard deviation of 0.88%. In the vertical meridian the mean difference between the two instruments was 0.15%, with a standard deviation of 0.93%. With the exception of one very atypical subject, the total range of error was ±1.75% of magnification, this range being the same for both meridians. The raw data are offered in Appendix I.

The correlation coefficients between measurements in the two instruments were 0.79 in the horizontal and 0.89 in the vertical meridian, these being significant at the 0.05 and 0.01 levels of confidence, respectively.

In only three cases was any declination measurable in the Space Eikonometer. In every case, the same declination was noted with the Telebinocular using the Eikonograms. The amounts were not identical but were fairly similar.
Correlation between the amount of aniseikonia induced and the amount measured, in each instrument, was 0.85. This shows that both instruments were not only revealing similar measurements, but also reflecting the amounts of aniseikonia induced, at a variety of levels, to a fairly faithful degree.

There was no relationship observed between the P.D. of the subject and the degree of error in measurements taken with the Telebinocular.

**CONCLUSIONS AND DISCUSSION**

This study shows that with a group of clinically unsophisticated subjects, measurements taken with the telebinocular, eikonograms and size lenses were generally accurate to within 1.00% of measurements taken with the Space Eikonometer, within a range of 0% to 3.5% of induced magnification, whether at axis 90 or 180. Declination is also reflected in the Telebinocular, though insufficient data were available to make this trend any more precise.

The ability of the Telebinocular to replicate Space Eikonometer findings was encouraging, particularly in view of some of the obstacles involved.

The main problem with the Telebinocular is the amount of pin-cushion distortion of the target induced by the spheroprism in the eyepiece of the instrument. This affects the perception of the cross in particular, whose arms appear considerably curved, making the rotation or tilting of the cross especially difficult to judge. It was clear, during the study, that most observers found judgments considerably more difficult in the Telebinocular than in the Space Eikonometer.
Another problem of the Telebinocular is that several subjects, with large eye-size spectacles, were unable to get their foreheads solidly against the head rest, since the spectacles prevented them from "getting into" the instrument to a proper depth. Head instability resulting from this made judgments more difficult, apparently. This is quite an important factor. On the other hand, this problem can sometimes be circumvented if necessary by taking measurements through trial lenses in a trial frame, if it is a small compact one.

The authors feel that the Telebinocular, Eikonogram, Size Lens approach employed shows considerable promise as a measurement technique. Even in its present form the technique, in our opinion, goes beyond the category of a "screening device" and could be employed as a rough alternative to measurement with the Space Eikonometer. This is felt to be even more appropriate if certain additional precautions are taken:

1. Take several measurements, preferably on more than one occasion.

2. Give subjects more time to become sensitive to depth cues. Practice did seem to help considerably in responding.

3. Ensure a stable head position in the instrument, with the head placed firmly against the headrest.

4. Try out one or two aniseikonic corrections tentatively before prescribing a definite correction. The ability to do this is one of the advantages that accrues from owning a set of size lenses - they can be used for both testing and trial prescribing.

Beyond these precautions, and of perhaps even greater importance, the authors feel that if the Mast-Keystone Company could introduce distortion-free sphero-prisms in the eyepiece of the Telebinocular,
by replacing those used in current manufacture, its potential for accurate aniseikonia measurement, with the technique proposed, could be vastly improved. More research in this direction is desirable. The company might then offer to ophthalmic practitioners, a new aniseikonia kit, to include a small set of eikonograms, a set of about twenty size lenses for measurement and trial prescribing and a revised set of the excellent manuals on Aniseikonia measurement and corrective lens design.
REFERENCES


APPENDIX I

RAW DATA

Numbers in the DATA rows below (n=30) represent variables in the following sequence:

1. Subject’s P.D.
2. Induced Aniseikonia x 90
3. Induced Aniseikonia x 180
4. Eikonometer Reading x 90
5. Eikonometer Reading x 180
6. Telebinocular Reading x 90
7. Telebinocular Reading x 180
8. Error x 90 (Item 6 minus Item 4)
9. Error x 180 (Item 7 minus Item 5)

1550 DATA 70, 5, 5, 5, 5, 0, 75, 75, 25, 25
1551 DATA 61, 5, 5, 5, 0, 5, -25, 25, -25, -25
1552 DATA 66, 5, 5, -75, 1.25, -5, -5, 25, -1.75
1553 DATA 64, 1, 1, 1.5, 75, 75, 75, -75, 0
1554 DATA 65, 1, 1, 25, 5, -25, 25, -5, -25
1555 DATA 70, 1, 1, 1.75, 5, 1.25, 1.25, -5, 75
1556 DATA 68, 2, 2, 3.25, 1.75, 1.5, 2, -1.75, 25
1557 DATA 61, 2, 2, 2.25, 1.5, 1, 1, -1.25, -5
1558 DATA 62, 2, 2, 2.25, 2, 2, 1.5, -25, -5
1559 DATA 57, 3, 3, 2.25, 2.5, 2.75, 3.25, .5, 75
1560 DATA 60, 3, 3, 4, 3.5, 2, 2, -2, -1.5
1561 DATA 68, 3, 3, 3.5, 2.5, 3, 2.75, -5, -25
1562 DATA 64, .5, 0, 75, 5, 5, 1.5, -25, 1
1563 DATA 64, .5, 0, -1, 0, -1.5, 0, -5, 0
1564 DATA 64, .5, 0, -25, -5, -5, -1, -25, -5
1565 DATA 58, 1.5, 0, 2, 25, 1.5, 5, -5, 25
1566 DATA 63, 1.5, 0, 1.25, -1, 75, -25, -5, -5, -25
1567 DATA 60, 1.5, 0, 1.75, 25, 1, 0, .75, -25
1568 DATA 61, 2.5, 0, 2.75, -25, 2.5, 0, -25, 25
1569 DATA 60, 2.5, 0, -5, -2.25, 3.5, -1.75, 3, -4
1570 DATA 61, 2.5, 0, 3, 5, 2.5, 1, -5, 5
1571 DATA 64, 0, 5, -75, -1.5, -5, 1.25, 25, 25
1572 DATA 68, 0, .5, 0, .5, 0, .75, 0, .25
1573 DATA 59, 0, .5, -1, -1.25, -1, -1.5, 0, -25
1574 DATA 60, 0, 1.5, 0, 1.5, 0, 1.25, 0, -25
1575 DATA 65, 0, 1.5, -75, 5, 0, 1.75, 0
1576 DATA 63, 0, 1.5, 1, 1.5, 2, 1.5, 1, 0
1577 DATA 64, 0, 2.5, .25, 2.5, 5, 2.5, 25, 0
1578 DATA 60, 0, 2.5, -25, 2.5, 5, 2.5, 75, 0
1579 DATA 60, 0, 2.5, 0, 2, 0, 1.5, 0, -5