age of ten months the legs became painful and swollen, the
swelling being marked and extending from the knees to the
ankles. No hemorrhages appeared in the skin, and at no
time were the gums swollen. A pseudoparalysis of the legs
was present, and a diagnosis of rheumatism was made.
When the correct diagnosis was established, the diet was
changed to raw cow’s milk and orange-juice, one dram of the
latter three times a day. Within four days the exophthalmos
had disappeared, the swelling of the legs had gone, and the
child appeared greatly improved in every way. There have
been no further relapses, and the child to-day is robust and
healthy.

DISCUSSION.
DR. E. E. JACK, Boston, Mass.: Dr. Blake’s statement
that 10 per cent. of infantile scurvy cases have exophthalmos
surprises me, because in a service of 15 to 20 years at the Bos-
ton Children’s Hospital, I remember only one case. That
recovered promptly.

THE RELATION OF HEADACHE TO FUNCTIONAL
MONOCULARITY.

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Headache is indisputably the most common symptom for
the relief of which patients consult the ophthalmologist.
Snydacker found that in 2,000 consecutive patients, 40 per
cent. complained of headache. Brav, in 3,000 consecutive
cases, found that 30 per cent. asked relief from headache,
there being no other symptoms. Approximately three out
of every four of our patients (excluding those with acute
inflammatory conditions) complain of headache or give a
history of having had headache in some form. Yet there
are many patients who rather surprise us by stating that they
do not have, or that they never have had, headache. Vol-
umes have been written about headache, especially that
associated with eye-strain or some form of ocular maladjustment, but scarcely anything has been said about the cephalalgic patient. Therefore I trust that the statistics which I herewith present may have some scientific value and interest.

This paper is the study of 1,010 cases of partial or of complete functional monocularity, and the relation of such conditions to the prevalence of headache.

When one considers the class of cases which are relatively less subject to headache, it seems to be quite universally accepted that the higher degrees of hypermetropia are less likely to cause asthenopic symptoms than the lower or the intermediate degrees; and that myopia, corrected and uncorrected, is less likely to cause headache than hypermetropia. One author presents these observations by saying, "Poor vision excludes eye-strain." The question of the prevalence of headache among the blind has been studied by Walton, who found that 66 per cent. of persons blind from infancy were free from headache. Later he investigated the frequency of migrainous headache among the blind and found it only one-half as frequent among the blind as among seeing persons of like age and conditions.

Several years ago I was impressed with the fact that many patients with only one useful eye often have a history of the absence of headache. A search through the literature revealed only a few references relative to this observation. I found the unique and well-known case of Dr. Noyes, in which the removal of a nearly normal eye, having standard vision, afforded complete relief to a patient who had suffered for years almost constant "agonizing headache" and other asthenopic symptoms. Ranney states that "a typical cross-eye is not, as a rule, the cause of serious nervous disturbance —eye-strain is practically absent in extremely cross-eyed subjects." Wilder, in writing of the visual standards in the army, states that persons with congenital amblyopic eyes are "seldom annoyed by asthenopia if the fellow-eye has
fairly good vision and no great refractive error, for they do not have binocular single vision." Oliver, in the chapter on Ametropia in Norris and Oliver's "System of Diseases of the Eye," says: "Were the human eye cyclopic, the problem (asthenopia) would be easier of solution, and eye-strain would be less disastrous in its consequences." Donders ("Accommodation and Refraction of the Eye," p. 415), as early as 1864, made the observation that asthenopia was overcome by strabismus convergens or divergens, and expressed the fact in the following striking antitheses: "Hypermetropia causes accommodative asthenopia to be actively overcome by strabismus convergens. Myopia leads to muscular asthenopia, passively yielding to strabismus divergens."

Although all of these references indicate at least a mitigation of asthenopic symptoms in proportion to the loss or absence of single binocular vision, I could find no reference to any statistics to substantiate these opinions or my own belief that the monocular are comparatively free from headache. Therefore I have undertaken a study of a series of cases falling within the class of the functionating monocular, believing that such a study would be interesting and would shed some light on this subject. I have taken from my files 1010 cases having different degrees of monocularity and have tabulated them. In the tabulation I have recorded for each patient the age, occupation, refraction, visual acuity, muscle balance, condition of general health, and the presence or absence of headache or head-pain. For simplicity, the cephalalgias were divided into two classes only—the severe or habitual, and the mild or occasional.

In selecting the cases for tabulation the following were excluded: cases under fifteen years of age; cases in which the vision of the better eye was less than 20/25, and those clearly showing the presence of some active local or constitutional disease. In excluding persons under fifteen years of age we felt that, prior to this age, a sufficient period of time
had not elapsed to establish the fact of the presence or absence of habitual headache; that the personal history of these patients in regard to headache would often be unreliable; and, further, that, prior to fifteen, especially with girls, many other factors incident to the beginning of adolescence concern the etiology of headache. Only those cases in which there was present a central visual acuity of 20/20 or 20/25 in the better eye were used, as a perfect, or nearly perfect, vision in one eye was desirable in considering monocularity. The visual test was recorded and considered with the use of glasses when the patient was wearing them, and without glasses when the patient was not using them. The reason for excluding those with active constitutional or local ocular diseases is self-evident, as such conditions would have a direct relationship to the presence of headache.

Considering the different degrees of disturbances of binocular single vision the cases seemed rather naturally to fall into the following four groups: I. The one-eyed; II. The anisometropic; III. The amblyopic; IV. The strabismic. The first group contains all those cases which had lost one eye, considering only those in which the monocularity had existed for five years or more, and those having only one good eye, the other eye having an acuity of less than 10/250; the second group includes those cases of anisometropia in which binocular single vision was not present or in actual use, also a limited number of cases presenting a very marked dominance of one eye, although in these latter cases single binocular vision was present and visual acuity was standard in each eye; the third group includes all cases of monocular amblyopia; the fourth group includes all cases of strabismus, both convergent and divergent, constant or intermittent.

Group I. Complete Monocularity.—In this group there were 96 cases. Of these, 30 had been blind in one eye for five to twenty years; 40 had been blind in one eye for twenty
to thirty years; and 26 had been blind for forty years or more. Headache of a severe or habitual type was found in only 2 cases. One case had suffered headache for a period of twenty years, and the other for forty-five years. Six cases gave a history of an occasional or mild headache. Therefore only 2 per cent. of the absolute monocular patients showed habitual or severe headache, and 6.2 per cent. occasional or mild headache, or a total of 8.3 per cent. having any form of headache. In this group there were 8 cases which gave a history of severe or habitual headache before losing an eye, and a complete absence of all headache after the loss of an eye.

**TABLE SHOWING THE NUMBER OF CASES AND THE PERCENTAGE OF HEADACHE.**

<table>
<thead>
<tr>
<th>Group</th>
<th>Kind or Degree of Monocularity</th>
<th>Total Number of Cases</th>
<th>Number without Headache</th>
<th>Number Having Habitual Headache</th>
<th>Number Having Occasional Headache</th>
<th>Total Number with Headache</th>
<th>Percentage of Headache</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Binocular</td>
<td>1010</td>
<td>298</td>
<td>606</td>
<td>106</td>
<td>712</td>
<td>70%</td>
</tr>
<tr>
<td>I.</td>
<td>One-eyed or absolute monocularity</td>
<td>96</td>
<td>88</td>
<td>2</td>
<td>6</td>
<td>8</td>
<td>8.3%</td>
</tr>
<tr>
<td>II.</td>
<td>Anisometropia or suppressed monocularity</td>
<td>120</td>
<td>105</td>
<td>5</td>
<td>7</td>
<td>15</td>
<td>11.4%</td>
</tr>
<tr>
<td>III.</td>
<td>Amblyopia or relative monocularity</td>
<td>546</td>
<td>436</td>
<td>44</td>
<td>66</td>
<td>110</td>
<td>20.1%</td>
</tr>
<tr>
<td>IV.</td>
<td>Strabismus or functional monocularity</td>
<td>248</td>
<td>192</td>
<td>24</td>
<td>32</td>
<td>56</td>
<td>22.6%</td>
</tr>
<tr>
<td>Total for Groups I, II, III, and IV</td>
<td>1010</td>
<td>821</td>
<td>75</td>
<td>111</td>
<td>189</td>
<td>18.7%</td>
<td></td>
</tr>
</tbody>
</table>

**Group II. Anisometropia or Suppressed Monocularity.**—In this group are included two classes of cases: first, those of unequal vision (anisopia), due to a high degree of anisometropia, so that only one eye was functioning with good central visual acuity; while the other, although having a
possible standard visual acuity with proper glasses did not or could not adapt itself to the use of the correction for that eye having the greater refractive error. Generally there was a difference in the spheric correction of the two eyes of more than four diopters. Second, those with one very dominant eye, but with equal vision (isopia), the monocular dominance

| B = binocular cases; I, II, III, IV = groups. Solid column = percentage habitual headache cases. Hollow column = percentage occasional headache cases. Entire column = percentage for all headaches for each group. Horizontal lines = percentage headache for age period for groups B and I, II, III, and IV. |

being determined by the winking test of Rider, and because of an habitual desire or habit almost constantly to close one and the same eye.

In this group there were 120 cases of which 93 had anisopia and 27 isopia. Of the former, 5, or 5.3 per cent., had severe or habitual headache, and 6, or 6.4 per cent., occasional or mild headache; and of the latter none had severe or habitual
headache, and 1, or 4 per cent., had mild or occasional headache. Taking the group as a whole and including both classes of headache, the total percentage of headache was found to be 11.4 per cent.

In 3 of the cases of anisometropia a persistent attempt had been made to use correcting glasses, but these always caused the recurrence of severe headache. Without the glasses or with only the better eye corrected these patients were perfectly comfortable and free from headache.

**Group III. Amblyopia or Relative Monocularity.**—This group includes all cases of monocular amblyopia. These cases were divided into four classes, depending on the visual acuity of the amblyopic eye. The best vision with correcting glasses was taken in every case, and the question of cephalalgia was considered with the use of correcting glasses. In each class are included all cases with vision in the amblyopic eye as follows: (Vision in the non-amblyopic eye, with glasses, being 20/25 or better) Class A, 20/33–20/40; Class B, 20/50–20/65; Class C, 20/80–20/160; Class D, 20/200–10/250. In Class A there are 120 cases. Of these, 10, or 8.3 per cent., had severe or habitual headache, and 24, or 20 per cent., had slight or occasional headache. In Class B there were 122 cases. Of these, 4, or 3.2 per cent., had severe or habitual headache, and 14, or 11.6 per cent., had occasional or mild headache. In Class C there were 119 cases. Of these, 8, or 6.7 per cent., had severe or habitual headache, and 10, or 8.3 per cent., had mild or occasional headache. In Class D there were 185 cases. Of these, 18, or 10 per cent., had severe or habitual headache, and 23, or 12 per cent., had mild or occasional headache. Comparing the classes in this group we find that the percentage of headache, considering both classes of headache together, shows a proportionate decrease with the decrease of visual acuity in the amblyopic eye, except in Class D, where the total percentage of headache considerably increased. The percentage for each class
was A, 30 per cent.; B, 15 per cent.; C, 14 per cent.; and D, 24 per cent. I find that in Class D I had included 8 cases of migraine associated with severe headache. Had these been omitted, the percentage in this class would have been 17 instead of 24. The total percentage of headache for all classes in this group was 20.1 per cent.

Group IV.—In this class are placed all strabismus cases of every form or degree. There are a total of 248 cases; 7 had vertical deviation, 114 were convergent cases, and 127 were divergent cases. In 6 of the convergent cases, and in 39 of the divergent cases, the squint was not constant. Of the total 114 convergent cases, 12, or 10 per cent., had a history of habitual or severe headache, and 15, or 13 per cent., slight or occasional headache. Of the total 127 divergent cases, 12, or 9 per cent., had habitual or severe headache, and 17, or 13 per cent., slight or occasional. The convergent and the divergent show practically the same percentage of prevalence of headache.

Considering all forms of strabismus together, out of the total of 248 cases, 24, or 10 per cent., had severe or habitual headache, and 32, or 13 per cent., had occasional or mild headache, making a total for all forms of headache of 22.6 per cent. for the strabismus cases. In this group there was one case of isopia with intermittent convergent strabismus who suffered nearly daily with headache, especially after close work, until he learned to cover up one eye. This gave complete relief from the headache.

Considering all four groups together for the purpose of comparing the frequency of headache, we find that Group I (absolute monocularity) shows the lowest percentage of headache, only 2 per cent. having habitual or severe headache. Then comes Group II, in which there was functional suppression of single binocular vision (cases of high anisometropia) with 4.1 per cent. of habitual or severe headache. Next in order follow Group III (amblyopia), 8 per cent.,
and Group IV (strabismus), 10 per cent., with habitual or severe headache.

Considering both classes of headache, the habitual or severe and the occasional or slight together, the percentages as shown in the graph are for Group I, 8.3 per cent.; for Group II, 11.4 per cent.; for Group III, 20.1 per cent.; and for Group IV, 22.6 per cent. Thus we find that there was a proportionate smaller percentage of headache in proportion to the greater degree or completeness of monocularity.

In a review of the consecutive records of 1010 private cases having good binocular single vision (all cases falling under any of the groups considered in this paper being excluded, as well as all inflammatory cases), I find that the percentage of such cases having headache is 70, the habitual or severe headache being complained of in 60 per cent., and the occasional or mild in 10 per cent. Thus a comparison of an equal number of records of patients having constant binocular single vision with the monocular will show that severe or habitual headache occurs seven times more frequently in the former than in the latter.

There are many illustrative normally monocular patients in this series which demonstrate our premises in a converse way in that, by attempting to produce coördinate use of the eyes, severe and unconquerable asthenopic symptoms were produced. I shall not burden this paper with case histories, but shall insert abbreviated records of two cases, one of which illustrates the above point, and one which seemed to show that, by establishing monocularity, a severe cephalalgia and other asthenopic symptoms were relieved.

Case I.—Mr. J. P. H., aged fifty-five years, a college graduate, teacher by profession. Has never enjoyed very good health. Usual weight, 125 pounds. Has had recurrent symptoms of fatigue neurosis. Ocular history: Twenty-eight years ago had an operation for a divergent strabismus. Has always been near-sighted, and has worn glasses since
boyhood. Refraction at present: R.E. − 6.00 sph. ⊕ − .75
cyl. ax. 35° = 20/25; L.E. − 1.50 sph ⊕ − .75 cyl. ax.
180° = 20/20. Has fusion, but maintains it with difficulty;
slight convergence. For the past ten years has used full
correction for the left eye, and − 3.25 sph. ⊕ − .75 cyl.
for the right eye. With this latter correction he has enjoyed
perfect ocular comfort and has been entirely free from head-
ache, using the left eye for distant vision and the right eye
for near. About ten years ago he tried persistently, under
the care and direction of a competent oculist, to use the full
correction for each eye, but was unable to do so because of
severe asthenopic symptoms which this produced.

Case II.—Mrs. H. R. H., aged thirty-nine years. General
health good; has not had any serious illness, but has always
had a nervous temperament and describes many recurrent
attacks typical of neurasthenia. Ocular history: Has suf-
fered considerable headache over a period of many years,
and has never been able to use her eyes without distressing
symptoms. While in college was under the care of a well-
known specialist, who spent several months in an attempt
to give her proper correcting glasses. During this time she
was unable to follow her college work, and lost several
months’ time. Has used glasses for twenty-five years.
Without glasses V.R.E., 20/80; L.E., 20/20. Refraction
under cycloplegic: R.E. − 1.75 sph. = 20/20; L.E. + .12
cyl. ax. 90° = 20/20.

This is practically the same correction which she used
while in college and since. She was told that it was very
essential that she wear her glasses, therefore has done so.
On April 18, 1919, the writer advised her to go entirely with-
out glasses. Since laying them aside she has been very much
more comfortable, has been able to use her eyes for longer
periods, and has been entirely free from headache. She
states that during the past two years she has not known
what a headache was, and that she has never been so com-
fortable in all her life. With the full correction there is only
a very slight muscle imbalance. In 1919, ½ degree of
exophoria. March 18, 1921, exophoria, 1½°; right hyper-
phoria, ½°.
A study of the age epoch in the relation to the frequency of headache reveals a striking similarity both in the binocular and in the monocular, there being a slight peak of greater proportion between the ages of fifteen and twenty years, then a sharp but small decline, the percentage then being maintained at a nearly uniform ratio between twenty and thirty-five. Between thirty-five and forty-five the proportion of headache greatly increases, reaching the highest peak at forty-five or forty-six. From this age the percentage curve is sharply downward, passing below the curve of youth and adolescence at fifty-five. From this age onward there is little fluctuation.

An explanation for the infrequency of headache in the monocular patient as compared with the patient employing single binocular vision is found in the fact that the former, because of his monocularity, must experience less nervous or brain fatigue, the normal monocular visual act being less complex because of the elimination of the fusion sense and of coördinate muscular adjustment which are necessary in maintaining single binocular vision.

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