



Test-types for the determination of the acuteness of vision

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FOR THE

DETERMINATION OF THE ACUTENESS OF VISION,

BY

H. SNELLEN, M. D.

SURGEON TO THE NETHERLANDS OPHTHALMIC HOSPITAL AT UTRECHT.

Printed by P. W. VAN DE WEIJER, Utrecht.

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The profits of this edition are for the benefits of the Netherlands
Ophthalmic Hospital.



To determine the acuteness of vision, we measure the smallest angle at which objects of known size and known form are distinguished.

The value of the angle at which the eye perceives definite objects depends on the number of percipient nerve elements which are implicated by the retinal image. The percipient elements, however, are not distributed in equal number over every part of the retina, but decrease in a certain order from the centre of the yellow spot to the periphery.

Correctly speaking, the acuteness of vision would be inversely proportioned to the number of percipient retinal elements which, at the smallest visual angle under which definite forms are recognized, are implicated by the retinal picture. On this account the determination of the acuteness of vision, being in inverse ratio to the smallest visual angle, does not afford us an absolute but only a relative value.

To determine visual angles we measure the extreme distance, at which objects of definite size (e. g. letters) can be recognized, or we measure the size of the objects which can be distinguished, when placed at a definite distance (e. g. one foot).

The angles at which objects appear may be said to stand in inverse proportion to the distance & in direct proportion to the size of the objects, provided the angles are small; if however larger angles are concerned, then the size of the object must be assumed to be twice that of the tangent of half the angle.

Square letters whose limbs have a width equal to one fifth of the letters height are generally distinctly visible to a normal eye at an angle of five minutes.

As objects susceptible of mutual comparison, capital letters of the type known as Egyptian Paragon have been selected: They are square letters all whose limbs, whether horizontal or vertical, are of one thickness.

To attain, if possible, more uniform distinctness I, J, M, Q, W, X, are omitted.

As a standard of vision we adopt clear & accurate perception, not uncertain recognition of objects.

The sizes of our letters, as well as that of the interstices by which they are separated, accurately measured off upon the lithographic stone, are as follows:

No. I = 0,209 Paris lines.	No. XI = 2,304 Paris lines.
„ II = 0,419 „ „	„ XII = 2,513 „ „
„ III = 0,628 „ „	„ XV = 3,141 „ „
„ IV = 0,838 „ „	„ XX = 4,189 „ „
„ V = 1,047 „ „	„ XXX = 6,283 „ „
„ VI = 1,257 „ „	„ XL = 8,377 „ „
„ VII = 1,466 „ „	„ L = 10,472 „ „
„ VIII = 1,675 „ „	„ LXX = 14,660 „ „
„ IX = 1,885 „ „	„ C = 20,943 „ „
„ X = 2,094 „ „	„ CC = 41,886 „ „

The number surmounting the type expresses in Paris feet the distance at which the letters are seen at an angle of 5'.

THE DEGREE OF ACUTENESS OF VISION (V) IS EXPRESSED BY THE RELATION OF THE DISTANCE AT WHICH THE LETTER IS ACTUALLY SEEN (d), TO THAT AT WHICH THE LETTER IS APPARENT AT AN ANGLE OF FIVE MINUTES (D).

$$V = \frac{d}{D}$$

If d and D be found equal, & No. XX be thus visible at a distance of 20 feet, then $V = \frac{20}{20} = 1$; in other words, there is normal acuteness of vision. If, on the contrary, d be less than D, and if No. XX is only visible at 10 feet, No. X only at 2 & No. VI only at 1 foot, these three cases are thus expressed respectively:

$$V = \frac{10}{20} = \frac{1}{2}$$

$$V = \frac{2}{20} = \frac{1}{10}$$

$$V = \frac{1}{20}$$

d may sometimes be greater than D, & No. XX be thus visible at a greater distance than 20 feet. In this case vision is more acute than the normal average.

Perfect acuteness of vision occurs only with exact accommodation for the given distance. By means of a complete series of test-types the limits of accommodation & refraction can thus be ascertained.

Since the acuteness of vision, within the limits of accommodation, is necessarily the same for every number, it follows that experiments with letters of different sizes, placed at appropriate distances, supply a test of the patients sincerity & ensure the detection of attempts on his part to simulate, exaggerate or dissemble.

In astigmatism horizontal and vertical lines cannot be seen with equal clearness at one and the same time, because in it the focal distances in the two meridian planes are unequal: In consequence of this, the squares of a draught board appear elongated in one direction as grey lines.

The extremes of difference in refraction, in cases of astigmatism, are found in meridian planes which are perpendicular to each other. The direction of these planes however usually deviates more or less from the horizontal and vertical.

The size of the pupil is not without its influence upon the acuteness of vision. If there be little light, vision is more acute in proportion to the dilatation of the pupil; contraction of the pupil, on the contrary, increases the acuteness of vision, where accommodation is imperfect, or where diffuse light comes into play.

The amount of light required for vision is variable & depends especially upon the degree of light to which the eye has been exposed the moment previously.

Our letters appear nearly alike distinct to normal eyes, whether they be printed in black upon a white surface, or in white upon a black surface.

Slender letters are perceived better under the later, whilst thick letters are better seen under the former conditions.

When the acuteness of vision is lessened, especially if the diminution results from diffuse light arising from turbidity of the refractive media, white upon black is better seen than black upon white.

Coloured letters or white letters with coloured illumination supply the means of ascertaining the acuteness of vision for each colour. In limited light all colours are not equally well perceived by every eye. If the refractive media of the eye have a certain colour, that colour is seen better than its complementary colour; in colour-blindness relatively more light is required to make those colours clearly visible, in regard to which sensibility is impaired.

Prolonged contemplation of one colour produces temporary colour-blindness.

The normal acuteness of vision decreases with age. (1)

Reading must not be identified with the recognition of isolated letters: in one respect reading is easier, because some letters can be guessed from their conjunction with others; in another respect it is more difficult because the letters of words, as they are usually printed, are very closely arranged.

In experiments in reading, fluency is chiefly to be regarded. With a contracted or interrupted visual field reading is less fluent.

The reading-tests appended to our letter-tests are printed in type as nearly as possible uniform with that selected for the latter.

As additional reading-tests where with to vary repeated examinations & to determine the degree of acuteness with which ordinary print is seen, we refer to JAEGER'S test-types: The letters in these are not square, are of unequal thickness & mutually dissimilar both in dimensions and definition. For these reasons they are not quite comparable with our letter-tests. If, by measuring the height of the lines, we determine the number, which expresses the distance at which they appear under an angle of five minutes, then would (JAEGER'S Schriftscalen, 2nd edition Vienna, 1850).

No.	1 of Jaeger's Test-types	0,2 Paris lines	be nearly equal to	No.	I.
" 5	" "	" 0,45	" " " "	" " "	II.
" 7	" "	" 0,6	" " " "	" " "	III.
" 11	" "	" 0,85	" " " "	" " "	IV.
" 13	" "	" 1,15	" " " "	" " "	V.
" 14	" "	" 1,5	" " " "	" " "	VII.
" 18	" "	" 3,75	" " " "	" " "	XVIII.
" 19	" "	" 5,3	" " " "	" " "	XXVII.
" 20	" "	" 8	" " " "	" " "	XXXVIII.

(1) We hope to be able to communicate at a future time additional data concerning this point. S.

VII.

F H K O S U Y A C E G L 7

VI.

N P R T V Z B D F H K O 6

V.

S U Y A C E G L N P R T 5

IV.

V Z B D F H K O S U Y A 4

III.

C E G L N P R T V Z B D 3

II.

F H K O S U Y A C E G L 2

I.

F H K O S U Y A C E G L 1

XV.

N P R T V Z B D F H K O 15

XIII.

S U Y A C E G L N P R T 12

X.

V Z B D F H K O S U Y A 10

VIII.

C E G L N P R T V Z B D 8

XXX.

F H K O S 3

XX.

U Y A C E G L 2

II.

P

R

T

5

XII.

V

Z

B

D

4

II.

CLAUDIUS CIVILIS WAS A BATAVIAN OF NOBLE RACE, WHO HAD SERVED TWENTY-FIVE YEARS IN THE ROMAN ARMIES. HE WAS A SOLDIER OF FORTUNE, AND HAD FOUGHT WHEREVER THE ROMAN EAGLES FLEW. AFTER A QUARTER OF A CENTURY'S SERVICE HE WAS SENT IN CHAINS TO ROME, AND HIS BROTHER EXECUTED, BOTH FALSELY CHARGED WITH CONSPIRACY. SUCH WERE THE TRIUMPHS ADJUDGED TO BATAVIAN

II $\frac{1}{II}$

AUXILIARIES. HE ESCAPED WITH LIFE, AND WAS DISPOSED TO CONSECRATE WHAT REMAINED OF IT TO A NOBLER CAUSE. CIVILIS WAS NO BARBARIAN. LIKE THE GERMAN HERO ARMINIUS, HE HAD RECEIVED A ROMAN EDUCATION, AND HAD LEARNED THE DEGRADED CONDITION OF ROME. HE KNEW THE INFAMOUS VICES OF HER RULERS; HE RETAINED

III.

AN UNCONQUERABLE LOVE FOR LIBERTY AND FOR HIS OWN RACE. DESIRE TO AVENGE HIS OWN WRONGS WAS MINGLED WITH LOFTIER MOTIVES IN HIS BREAST. HE KNEW THAT THE SCEPTRE WAS IN THE GIFT OF THE BATAVIAN SOLDIERY. IT SEEMED A TIME TO STRIKE A BLOW FOR FREEDOM. THE DETAILS

III $\frac{1}{II}$

OF THE REVOLT HAVE BEEN CAREFULLY PRESERVED BY TACITUS, AND FORM ONE OF HIS GRANDEST AND MOST ELABORATE PICTURES. THE SPECTACLE OF A BRAVE NATION, INSPIRED BY THE SOUL OF ONE GREAT

IV $\frac{1}{II}$

MAN AND RISING AGAINST AN OVERWHELMING DESPOTISM, WILL ALWAYS SPEAK TO THE HEART, FROM GENERATION TO GENERATION. THE BATTLES, THE SIEGES, THE DEFEATS,

VI.

THE INDOMITABLE SPIRIT OF CIVILIS, STILL FLAMING MOST BRIGHTLY WHEN THE CLOUDS WERE DARKEST AROUND HIM, HAVE BEEN DESCRIBED BY THE

VII.^a_{ii}

GREAT HISTORIAN IN HIS MOST POWERFUL MANNER. THE HIGH-BORN ROMAN HAS THOUGHT THE NOBLE BARBARIAN'S PORTRAIT A

X.

SUBJECT WORTHY HIS GENIUS. THE STRUGGLE WAS AN UNSUCCESSFUL ONE. AFTER

XII.

MANY VICTORIES AND MANY OVERTHROWS, CIVILIS WAS LEFT ALONE.

The Gallic tribes fell off, and sued for peace. Even the Batavians became weary of the hopeless contest, while fortune, after much capricious hovering, settled at last upon the Roman side. Had Civilis been successful, he would have been deified; but his misfortunes, at last, made him odious in spite of his heroism. But

the Batavian was not a man to be crushed, nor had he lived so long in the Roman service to be out-matched in politics by the barbarous Germans. He was not to be sacrificed as a peace-offering to revengeful Rome. Watching from beyond the Rhine the progress of defection and the decay of national

2.

enthusiasm, he determined to be beforehand with those who were now his enemies. He accepted the offer of negotiation from Cerialis. The Roman general was eager to grant a full pardon, and to re-enlist so brave a soldier in the service of the empire. A colloquy was agreed upon. The bridge across the Nabalua was broken asunder in the middle, and Cerialis and Civilis met upon the severed sides. The placid stream by which Roman enterprise had connected the waters of the Rhine with the lake of Flevo, flowed between the imperial

commander and the rebel chieftain. — Here the story abruptly terminates. The remainder of the Roman's narrative is lost, and upon that broken bridge the form of the Batavian hero disappears for ever. His name fades from history: not a syllable is known of his subsequent career; everything is buried in the profound oblivion which now steals over the scene where he was the most imposing actor. The contest of Civilis with Rome contains a

3.

remarkable foreshadowing of the future conflict with Spain, through which the Batavian republic, fifteen centuries later, was to be founded: The characters, the events, the amphibious battles, desperate sieges, slippery alliances, the traits of generosity, audacity, and cruelty, the generous confidence, the broken faith, seem so closely to repeat themselves, that History appears to present the

selfsame drama played over and over again, with but a change of actors and of costume. There is more than a fanciful resemblance between Civilis and William the Silent, two heroes of ancient German stock, who had learned the arts of war and peace in the service of a foreign and haughty world-empire. Determination,

concentration of purpose, constancy in calamity, elasticity almost preternatural, self-denial, sonsummate craft in political combinations, personal fortitude, and passionate patriotism, were the heroic elements in both. The ambition of each was subordinate to the

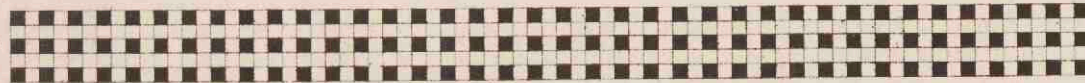
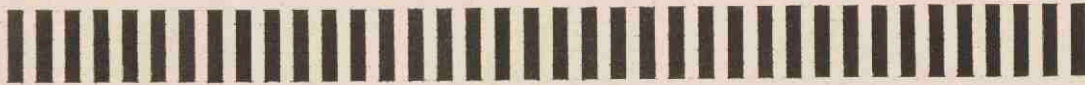
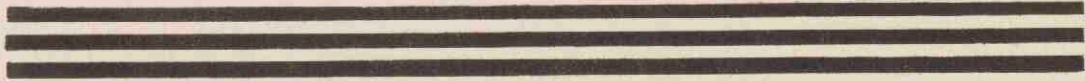
cause which he served. Both refused the crown, although each, perhaps, contemplated, in the sequel, a Batavian realm of which he would have been the inevitable chief. Both offered the throne to a Gallic prince,

for **Classicus** was but the prototype of **Anjou**, as **Brinno** of **Brederode**, and neither was destined, in this world, to see his sacrifices crowned with success.

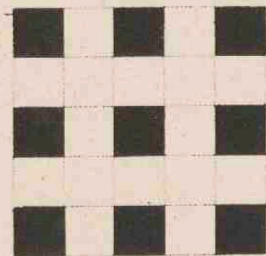
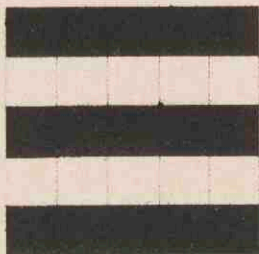
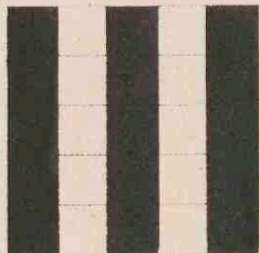
The characteristics of the two great races of the land portrayed themselves in the Roman and the Spanish struggle with much

the same colors: twice a Batavian republic took its rank among the leading powers of the earth; the

XX.



LXX.



E B F P T Z D L

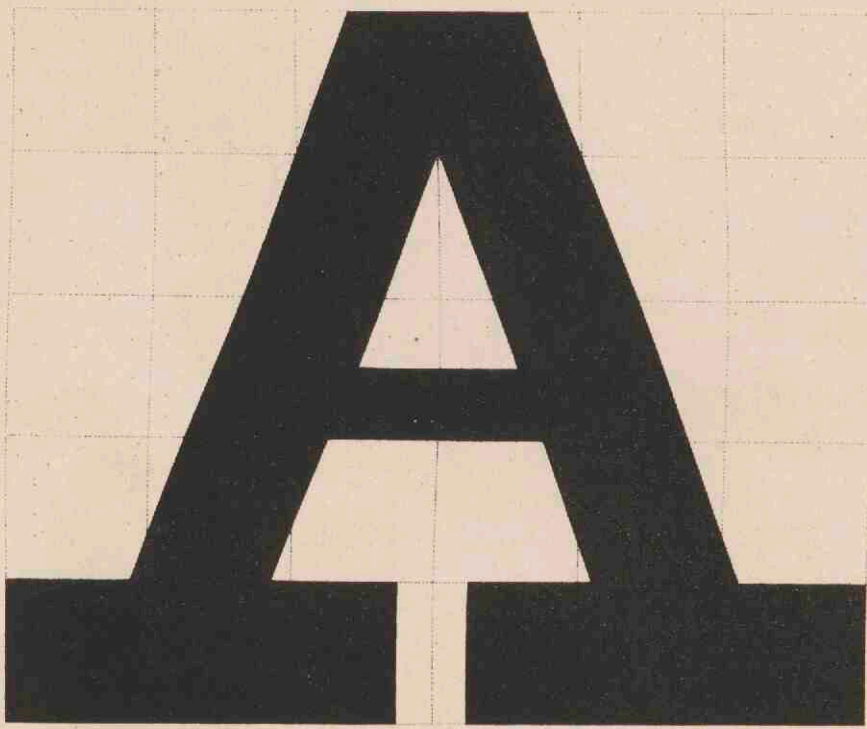
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B E P F Z T L D

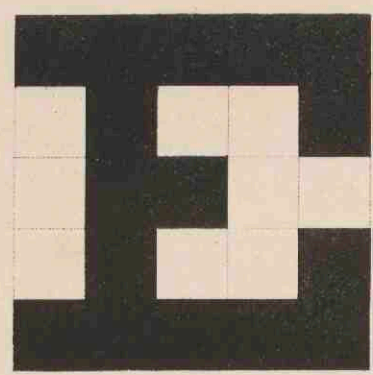
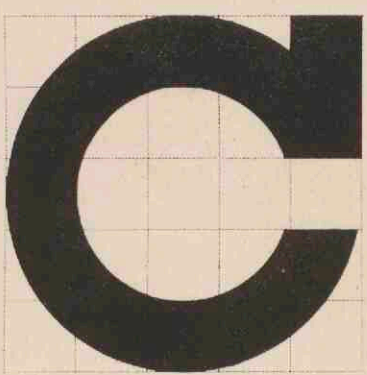
L D Z T P F B E

F P D L E B T Z

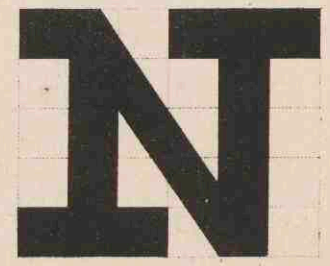
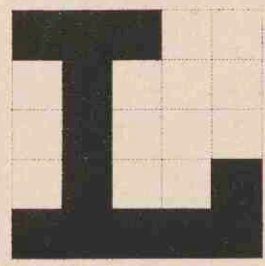
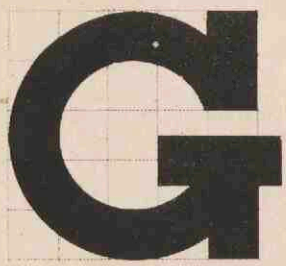
CC.



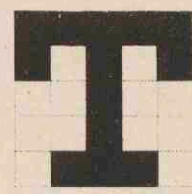
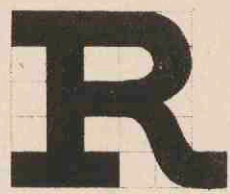
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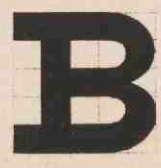
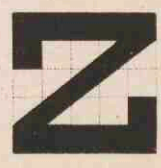
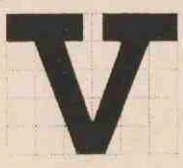
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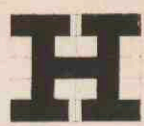
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XL.



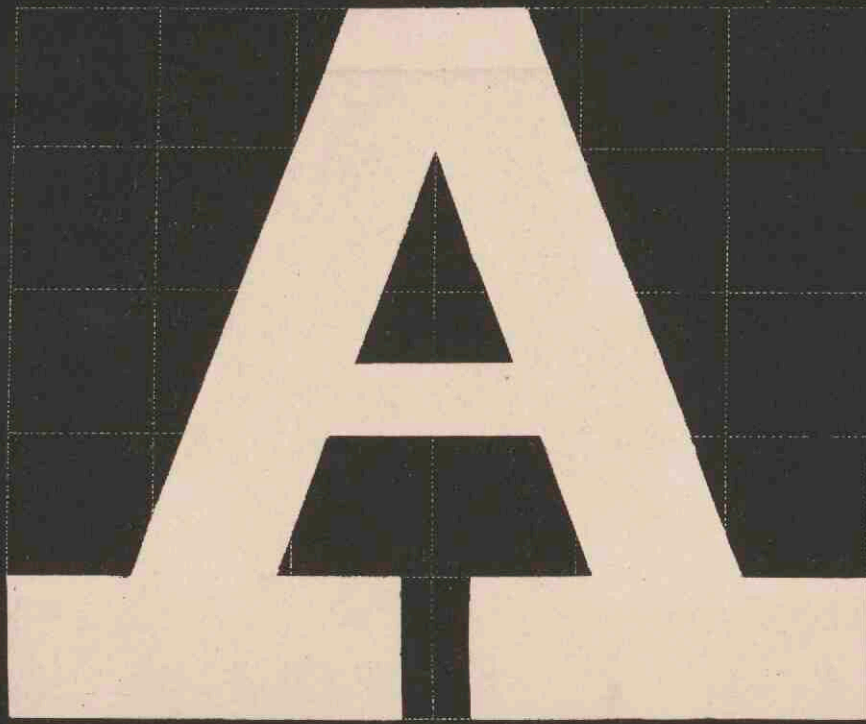
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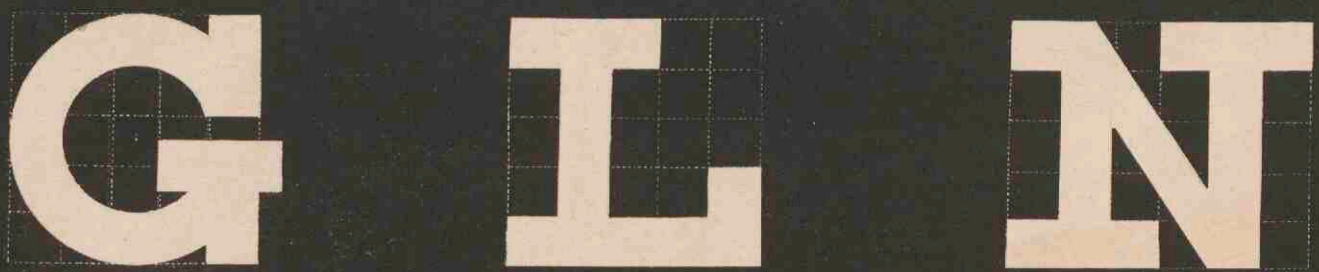
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C.



LXX.



L.



XI.



XXX.



XX.





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