EASTMAN KODAK COMPANY
ROCHESTER, NEW YORK 14650

PLEASE ADDRESS REPLY TO
RESEARCH LABORATORIES

TELEPHONE
AREA CODE 716 458-1000

February 18, 1971

Mr. R. Kuehni, Technical Dept.
Verona Corporation
P.O. Box 385
Iorio Court
Union, New Jersey 07083

Dear Mr. Kuehni:

Thank you for your letter of January 22 and the data enclosed with it.

I tried the $\xi, \eta$ formulas that I published in Applied Optics and found that the average radius of the 20 ellipses you specified corresponds to 2.745 units of color difference, with a root-mean-square error of 43.8% of that mean, or 1.2 units of color difference. One of the radii of the D ellipse corresponds to 0.55 units of color difference. Radii of ellipses A, E, F, G, I and Rob are nearly as small. One of the radii of ellipse J amounts to 5.87 units and one of each of the B, J and K ellipses amounts to 5.1 units.

In accordance with your suggestion, I tried re-optimizing the coefficients of the formulas for $\xi, \eta$. I kept the average radius unchanged, because it was in the range you desire. The r.m.s. error is reduced to 27.2% of the average radius, or 0.745 units of color difference. The smallest radius is in ellipse R and is 1.08 units of color difference, according to the modified formulas. The semiminor axes of ellipses D, E, F, I, and Rob are between 1.08 and 1.31 units. The largest radius, 4.78 units, is also in ellipse R. The next to the longest is in ellipse O, with a semimajor axis of 3.82 units; F is nearly as long, 3.78 units, and then L and K, which are 3.74 and 3.69 respectively.

The formulas for $\xi, \eta$, modified to thus fit your estimated 50% acceptance ellipses are

$$\xi = 750b^3 - 43.4b^2 - 81546ab^2 + 53239ab + 6882a^2b - 4942a^2 - 9406a^{\frac{1}{2}} + 3760a^{\frac{1}{4}},$$

where $a = 10x/(3.05x+25.3y+1)$ and $b = 10y/(3.05x+25.3y+1)$,

$$\eta = 1931b-1335b^2+272b^3+73ab^2-43.5ab^3,$$

where $a = 10x/(4.3y-1.7x+1)$, $b = 10y/(4.3y-1.7x+1)$.

You may notice that I have eliminated two more terms from each of the formulas, i.e. $a^4$ and $a^3b$ from $\xi$ and a and $a^2b$ from $\eta$. These formulas should not be used outside the polygon on the chromaticity diagram that just encloses the centers of the ellipses you specified. Emphatically, they should not be applied to chromaticities on or near the spectrum locus. So you should not use them to plot a spectrum locus. Much more uniformly distributed ellipses, and more self-consistent data, are necessary for derivation of such formulas.

I do not recommend these formulas for general use and trust that you will not circulate or publish them. I supply them to you merely for your use to determine what is the highest correlation that can be obtained with the Davidson-Friede-Robinson data, by use of formulas tailored specifically for them.

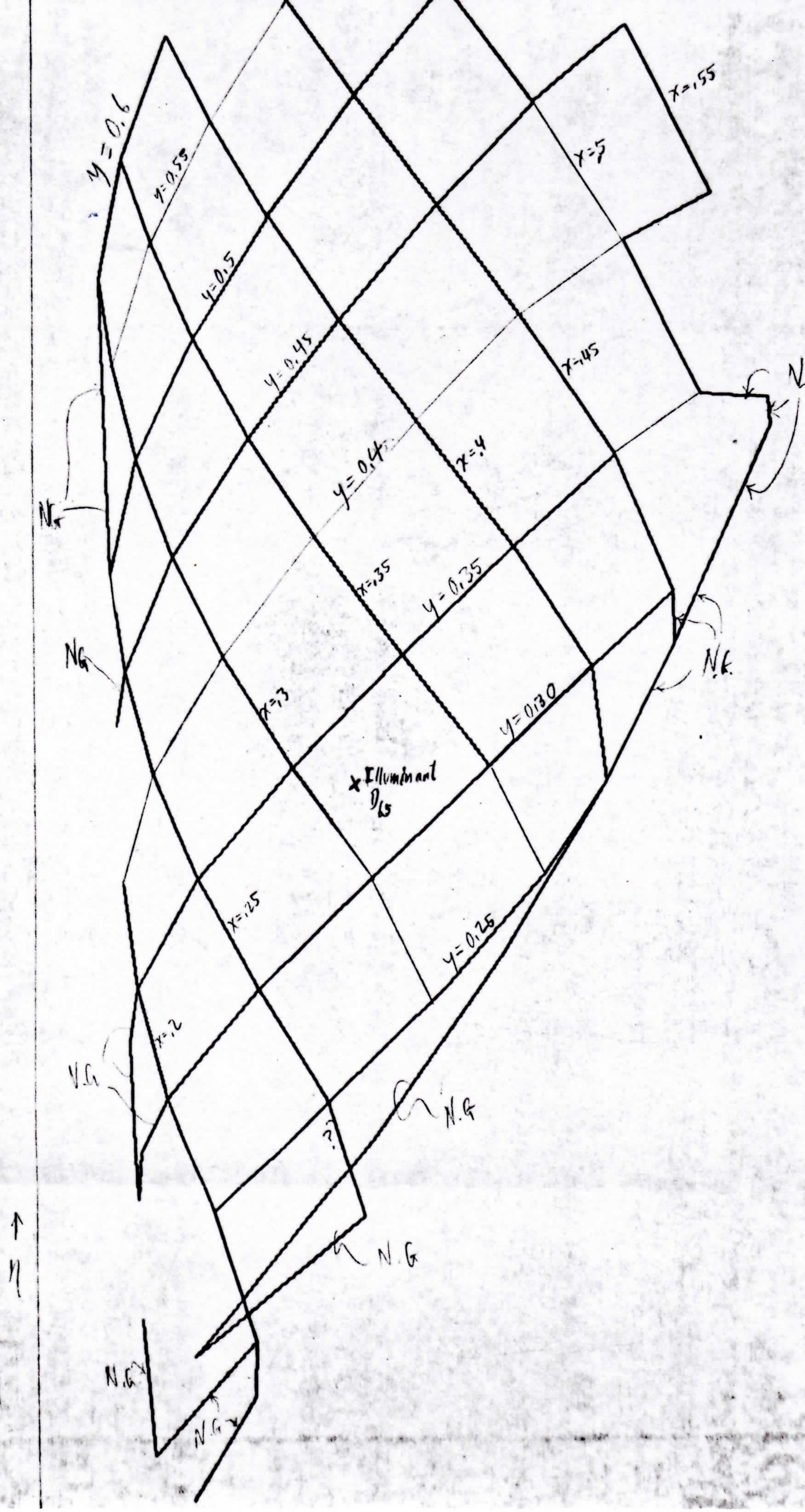
In order to check the reasonableness of these formulas, I arranged for our computer to plot some loci of constant x and y values on the redefined $\xi,\eta$ diagram. I enclose the result. It bears out your finding that these data might just as well be plotted directly on the x,y diagram. Within the region for which the $\xi,\eta$ formulas are valid, the x,y loci are nearly straight, equidistant and perpendicular to each other, as they are on the CIE 1931 coordinate system. Therefore, I would expect your circle formula to fit your data nearly as well as any possible formula. But, I believe that this is not the usual experience and that ellipses such as those I have published, on which my $\xi,\eta$ formulas are based, are generally more satisfactory than circles.

Very truly yours,

David L. MacAdam

Research Laboratories

DLMacAdam:jwj
Enc.



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y = 0.5
y = 0.45
y = 0.4
y = 0.35
y = 0.30
y = 0.25
x = .55
x = .5
x = .45
x = .4
x = .35
x = .3
x = .25
x = .2
N.G.
N.G
+ Illuminant $D_{65}$
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