+ 0.35 for stars of the photovisual magnitude 15 to
+ 1.40 for stars of the photovisual magnitude 17.

This corresponds to an increase in the mean colour
index of 0.27 for 1° increase of the photovisual mag-
nitude, while for the absolutely fainter stars here
under consideration the increase in the mean colour
index for 1° increase of the absolute magnitude is
only about half as great. Hence not even the extreme
assumption, that the stars of the apparent magnitude
17 are wholly two magnitudes fainter absolutely than
those of the apparent magnitude 15, is sufficient to
explain the rate of change in colour index with
apparent magnitude found by Sears.

Here it is at first sight tempting to think of
selective extinction of light in space. In fact the
mean colour index of Sears is + 1.02 for stars of
photovisual magnitude 16. Between the photovisual
magnitudes 15 and 16 the color index therefore
increases by 1.02 - 0.85 = 0.17 and between 16°
and 17° by 1.40 - 1.02 = 0.38.

If selective extinction in space is acting, the latter
value (0.38) ought, as is the case, to be greater than
the former (0.17). But the proportion between the
two 0.38/0.17 = 2.24 is too great, as it can at most
be 1.6. Another question is, whether the photographic
and photovisual scales of Sears have kept their
equality down to the very faintest stars examined.
At any rate the discordance between the observed
colour indices of very faint stars and the colours we
should expect them to have from a theoretical point
of view deserves further attention.

Perhaps the region round the Pole of the Milky
Way will be the most fit for a trial to settle the
question, because here the star density is falling off
most rapidly with increasing distance.

In this connection it may be remembered that the
effective wavelengths of absolutely faint stars only
show a regular increase with the absolute magnitude
for stars brighter than an absolute magnitude of about
+3. For stars absolutely still fainter the effective
wavelength remains practically constant (Mount Wilson
the colour indices found for absolutely faint stars do
not show this unexpected behaviour, as the mean
colour index, as far as the rather few observations
go, increases continuously with the absolute magnitude.

Remark on the relation between colour, proper motion and apparent magnitudes
of the stars, by Ejnar Hertzsprung.

In the Annalen van de Sterrewacht te Leiden, XIV,
part 1, I have considered anew the relation between
the colours of the brighter stars and their magnitudes
\( m \) reduced to the unit of proper motion \( \mu \), i. e.
\( m + 5 \log \mu \). The first investigation of this kind was
published by the present writer in the Zeitschrift für
wissenschaftliche Photographie 3 429; 1903, and led
to the discovery of the new series of stellar evolution
now known as „giants“ and „dwarfs“ (l. c. p. 442).

As long as we consider only stars contained in
that part of the universe near our sun, where the
star density may be taken as constant, stars with
the same value of \( m + 5 \log \mu \) will show no dependence
between colour and apparent magnitude. Practi-
cally all stars with annual proper motions exceeding
0.1 or even 0.05 are within this volume of constant
density. The accompanying diagram, which is to be con-
sidered as an extension of Figure 6 of the first quoted
paper, is based mainly upon stars of this kind. The
colour indices \( I_H \) of the Göttingen Actinometry were
used. For a number of faint stars, of which no colour
index was available, the colour index aequivalent to
the Mount Wilson spectrum has been adopted. The
diagram gives the relative numbers of stars between
the limits \(-0.6 \) to \(-0.4 \), \(-0.4 \) to \(-0.2 \), etc. of colour
index, for each interval of 1 (\(-6 \) to \(-5 \), \(-5 \) to \(-4 \),
e tc.) of \( m + 5 \log \mu \), expressed in percentages of the
total number in the same interval. The areas of the
circles are proportional to these percentages. The
total numbers for each interval are given at the bottom
of the diagram. Thus e. g. each of the three equal
circles in the last column (\( +12 < m + 5 \log \mu < +13 \))
represents one third of the whole number, i. e. in
this case 1 star, the colour indices being between 0.0
and 0.2, 0.6 and 0.8, and 1.0 and 1.2 respectively.
The total number of stars used is 994.

The scale of the reciprocal temperature \( c_4/T \) corre-
sponding to the colour index \( I_H \) has been added on
the diagram*). For indication of the absolute magnitude
to be expected from the value of \( m + 5 \log \mu \), the
formula (8) of Kaptein and van Rhijn on page 27
of the Astroph. Journ. 52; 1920 was used. This formula
may be written with only two constants as follows:

\[
\begin{align*}
m + 5 \log \sigma_m \mu &= -3.45 + 0.644 (m + 5 \log \mu) \\
\end{align*}
\]

The corresponding values of the probable absolute
magnitude have been indicated at the top of the

* The proportional scale of the two coordinates in the
diagram differs slightly from Fig. 6 of Annalen XIV, 1.

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The feature shown by the diagram is well known. Remembering the close general agreement between proper motion and parallax, we have a continuous series of stars from the absolutely bright white to the absolutely faint yellow ones and in addition to this firstly a number of white stars with great values of $m + 5 \log \mu$ and secondly a group of absolutely bright yellow stars not in distinct statistical connection with the others. *) This lack of apparent connection between the yellow luminosity-"giants" and the main continuous series is still more pronounced in the case of the systems of the Hyades and Praesepe, where the diagram of absolute brightness and colour can be drawn with much greater precision because all the stars belonging to one of these systems have practically the same parallax. (See HERTZSPRUNG, A. N. 5000, and VAN DEN BOS, B. A. N. 15).

Between the limits $3 < m + 5 \log \mu < 7$ practically only stars of the main series are found. For this interval the mean colour index $I_H$ is represented by $I_H - 6 = .04 (m + 5 \log \mu - 5)$. The deviation of a single colour index from this formula is $\pm .18$. Taking into account the mean error of the determination of the colour indices this mean deviation reduces to $\pm .16$. For these stars therefore the correlation between colour index and $m + 5 \log \mu$ is remarkably close. For the main series taken as a whole the relation between $m + 5 \log \mu$ and mean colour index is $I_H - 6 = .09 (m + 5 \log \mu - 5)$.

The above mentioned lack of stars of intermediate colour about 5 magnitudes absolutely brighter than our sun, is not explained by the form, in which H. N. RUSSELL has pleaded for the application of the views of LANE and LOCKYER to the series of the so called giants and dwarfs previously found (Zeitschr. für wiss. Photographie 3, 429; 1905). On the other hand the energy liberated by the contraction of a star is, according to EDDINGTON, of rather small importance in comparison with that produced by the building up of atoms. It is therefore possible that a star will remain longer at certain stages of its development than would be expected from a regular change in density.

*) It is possible that the absolutely bright yellow stars are connected partly with the absolutely bright white stars through the variables of the $\delta$ Cephei-type and partly (at about $m + 5 \log \mu = 4$ or $m + 5 \log \pi = 1$ and $I_H = .7$) with the absolutely dark yellow stars through stars of but slightly higher effective temperature.