Most previous studies of dark adaptation have
first light-adapted a portion of the retina and
then determined the subsequent course of sensitiv-
ity changes (threshold changes) within the area
just adapted. In the operational environment,
however, adapting sources and target lights seldom
occur in such an orderly fashion; we are interested
in knowing the sensitivity changes produced not
only within an adapting source but also outside of
it. For example, we are often concerned with the
effect of an adapting source at Point A upon sensi-
tivity at Point B or the effect of adapting sources
at Points A and B upon sensitivity at Point C. We
would often like to know the effect of adapting
sources such as instrument panel lights, farm
lights, and muzzle flashes upon an individual's
ability to see objects in other parts of his
visual field. Since these adapting sources vary
in color we must also determine the effect of
cromaticity upon these sensitivity changes.

In Figure 1, the large circle represents the
red or blue-white adaptation field, the small cir-
cles represent the unfiltered tungsten white thresh-
old test probes located either 10° inside of the
left edge of the adaptation field or 5° outside of
it and the dot at the extreme right edge of the
adaptation field represents the fixation point.
Also, in some conditions, the entire area was
covered with a green light having a luminance of
2.4x10^-3 footlamberts to simulate the luminance of
grass on a clear night with a full moon.

Two observers were first dark adapted for 45
minutes and then exposed to the lowest intensity
of the red adaptation field for 5 minutes. At the
end of this time, the adaptation field was turned
off and 10 seconds later the observer used the
method of adjustment (ascending trials only) to
determine his threshold within the area directly
illuminated (Point 1). The observer was then
re-exposed to the same adaptation field for 2
minutes and a second threshold judgment was ob-
tained in the same way. Immediately after this,
two more threshold judgments were made after 2-
minute adaptation exposures at the same adaptation
field intensity but on these two trials the thresh-
hold probe was presented outside of the area directly
illuminated (Point 2). Next, the intensity of the
adaptation field was increased to the next highest
level and the same procedures were repeated. After
threshold judgments had been obtained at all adap-
tation field intensities, the same pattern was re-
peated in another session except that this time
the adaptation field remained on while the thresh-
hold judgments were made. In still other sessions,
judgments were obtained for the blue-white adapta-
tion field in the same manner described above.
Finally, the moonlight field was added and all of
these procedures were repeated. Although not ana-
alyzed in a formal factorial manner, we can, for
convenience sake, describe this study as an AXBXC
study in which factor A was the lo-
cation of the test stimulus (either inside or out-
side of the adapting field), factor B was the
color of the adapting field (either red or blue-
white), factor C was the presence or absence of
the adapting field during the presentation of the
stimulus, factor D was the presence or absence of
the moonlight field, and factor E was the inten-
sity of the adapting field.

In studying the spreading of adaptational ef-
ects (sensitivity changes) to areas outside of
the adaptational field we are also interested in
discovering the mechanisms which produce such a
lateral spreading so that we can construct better
predictive models. One of the most obvious mecha-
nisms that must be considered is the effect of
stray light, i.e., to what extent is the threshold
performance outside of the area directly illumi-
nated determined by light scattered within the eye.
That is, the border of an image formed on the retina
is never sharp but rather consists of a luminance
gradient extending from the image all the way out
to the edge of the retina. Our strategy for assess-
ing the effects of stray light is as follows:
since stray light at any given point will have a
constant proportion of the adaptation field inten-
sity, to the extent that stray light is determining
the thresholds at Point 2 the curves for Point 1
and Point 2 can be brought into congruence by
simply shifting the Point 2 curves a certain con-
stant amount to the left (along the adaptation
field intensity axis).

It will be noted that achieving congruence by
a leftward shift of the Point 2 curves does not
prove that stray light is producing the results.
However, a failure (in certain directions) to
achieve congruence by such a shift does prove that
stray light alone cannot be producing the threshold
curves at Point 2.

It will be seen that in a number of instances
a leftward shift of about 1 log unit of the Point
2 curves produces some congruence with the Point
1 curves. Figure 2 shows the threshold curves for the condition in which the thresholds were determined 10 seconds after the adaptation field was turned off. The curves for inside (Point 1) and outside (Point 2) of the adaptation field have been superimposed after shifting the Point 2 curves 1 log unit to the left. It can be seen that the congruence is quite good except at the highest intensity.

Figure 2
In Figure 3, the Point 1 and Point 2 curves for the condition in which the adaptation field remains on during threshold determination are superimposed after a 1 log unit leftward shift of the Point 2 curves. A vertical shift also had to be made in order to bring the two sets of curves into reasonable agreement. It will be noted that the temporary levelling-off in the blue-white curves at Points 1 and 2, which probably represents the rod-cone break, occurs about 1 log unit later in the Point 2 curve than in the Point 1 curve. Finally, Figure 4 shows what happens when the moonlight field is added. The conditions otherwise are the same as for Figure 3. Again, some congruence is produced by shifting the Point 2 curves leftward by 1 log unit. In this case, the cross-over points of the Point 1 and Point 2 curves are brought into congruence by such a shift. The addition of the moonlight field, however, has reduced the overall congruence of the two sets of curves as compared to that in the other figures.

In general, there is some congruence in all of Figures 2 through 4 and a considerable amount of congruence in Figures 2 and 3. This indicates that stray light may play a large role in determining sensitivity outside of the adaptation field. However, in no case is there complete congruence which indicates that some additional, physiological, factor(s) must be at work in determining the Point 2 sensitivities. Furthermore, the rather large vertical shifts required in some instances are incompatible with an explanation based upon stray light alone.

CONCLUSIONS
1. With no moonlight field, under the stimuli configuration used in this experiment a large proportion of the sensitivity changes outside of the adaptation field can be accounted for by assuming a stray light background approximately 1 log unit less intense than the adaptation field;
2. The failure to achieve complete congruence of the Point 1 and Point 2 curves, however, indicates that the sensitivity changes outside of the adaptation field cannot be completely accounted for by stray light;
3. The addition of the moonlight field causes a curious reversal, such that at the lower adaptation field intensities the blue-white adaptation field produces lower thresholds than does the red adaptation field.

DISCLAIMER:
The views of the author do not purport to reflect the positions of the Department of Defense. Para. 4-3, AR 360-5).
LARGE FIELD = 13° 15'
SMALL FIELD = 1° 30'

Figure 1
ADAPTATION FIELD LUMINANCE

[ft-L]

Figure 2
Figure 3

THRESHOLD (Photopic Trolands)

ADAPTATION FIELD LUMINANCE (ft-L)
Figure 4

ADAPTATION FIELD LUMINANCE

[ft-L]
END
DATE
FILMED
4-82
DTIC