The ewes in groups 1, 2, and 3 did not appear to be disturbed by the treatment they or their lambs received; the ewes in groups 4 and 5 were disturbed only for the first few minutes after the mask was applied. All the ewes ruminated normally, and, in most cases, when the lambs sucked, they took up the attitude characteristic of suckling—that is, they depressed their hind quarters.

The effects of the treatments on the drive to suck were assessed in two ways. The first was based on the time after birth, at which the weight of the lamb began to increase through intake of milk. Owing to movement of the lambs during weighing, errors of 50 g were possible. The most likely time at which the lamb first increased in weight was therefore determined from a plot of the weights; usually it was clear-cut.

The second basis of assessment depended on the observed teat-seeking activity of lambs. To avoid the rigid demands of constant observation, ewes and lambs were each observed for a few seconds, and behavior noted once every ¼ hour (*4*). The number of observations in which lambs in the various groups appeared to be making active attempts to reach the udder or to suck during the first hour after birth were compared; both the proportion of lambs showing teat-seeking activity and the mean activity in each group were examined. No correction was made for the few observations in which the ewe was lying down so that attempts to suck could not be made. These observations appeared to be randomly distributed throughout the groups.

Results are shown in Table 1. In both 1962 and 1963, lambs that were not groomed and whose mothers could not orient toward them (group 2) were generally slower in gaining weight than control lambs (group 1). Neither difference alone was statistically significant (*5*), but the combined probability (*6*) was .04. Likewise, the teat-seeking activity in group 2 was lower in both years than in group 1. The difference in mean activity (*5*) in 1962 was significant; the combined probability (1962, 1963) was less than .05. Differences in the proportion of lambs showing teat-seeking activity were not significant (*7*).

The same general result was obtained by making similar comparisons between the treated groups in 1963; in group 5, in which orientation was permitted and the lamb was artificially groomed, the mean time taken for lambs to increase in weight was significantly less ($p < .05$) than the average of the groups in which either orientation or grooming or both was prevented (groups 2, 3, and 4). The mean teat-seeking activity in group 5 was also greater ($p < .01$) than in these other three groups combined. It is clear, therefore, that maternal assistance does facilitate the progress of the lamb toward successful sucking. The results also provide evidence about the relative importance of maternal orientation and of grooming. In the groups in which lambs were artificially groomed (groups 3 and 5, 1963) maternal orientation resulted in a significantly earlier increase in weight of lambs, and activity tended to be greater than when ewes were held. These trends were not seen in the absence of grooming. In the groups in which orientation was permitted (groups 4 and 5), artificial grooming resulted in a significantly greater "teat-seeking" activity, and there was a tendency toward an earlier increase in weight than in lambs which were not groomed, but these trends were not seen in the absence of orientation (groups 2 and 3).

Thus both orientation and the stimulation of grooming appear to facilitate the drive to suck and, presumably, increase the chances of survival. However, under the present experimental conditions it appears that neither orientation nor grooming alone increases the chances of successful sucking to any significant extent.

These results also show that under the present favorable conditions of close confinement of ewe and lamb and of mild air temperatures, active maternal assistance is not essential for most newborn lambs to find the teats and to suck.

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4. This procedure is not intended as a substitute for continuous observation, which is essential to the understanding of the behavior of newborn lambs during their initial search for the teats.
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Hue-Wavelength Relation Measured by Color-Naming Method for Three Retinal Locations

Abstract. *A method of hue measurement, in which an absolute color-naming procedure is utilized, has been applied to spectral stimuli delivered as flashes at 0 degrees, 20 degrees, and 40 degrees eccentricity in an otherwise dark field. The method yields very reliable measures, especially at 0 degrees. Color-naming at 0 degrees differs little from that at 20 degrees, but a marked deterioration of performance occurs between 20 and 40 degrees. This is reflected by a reduction in red and especially green responses, and a lower reliability of the measurements. Additional estimates were also obtained which showed a decrease in measured saturation but increasing reliability of the saturation measurements with increasing eccentricity.*

The relation between the wavelength of spectral radiant energy and perceived hue is so well known that it is commonplace to talk about light as if it were colored. This is of course misleading, since color is in the eye (and brain) of the beholder. For example, lights from the long-wavelength end of the spectrum, normally appearing red, become white near absolute threshold, appear black to certain color-defective observers, yellow if viewed peripherally, or even green under certain complex viewing conditions. Indeed, the hue of spectral radiation, as a function of wavelength, is known to depend upon at least a dozen parameters, excellently summarized by Burnham *et al.* (*1*).

Despite the influence of these many parameters upon the wavelength-hue relation, it is quite misleading to suggest, as does Land (*2*), that no such fundamental relation exists. On the contrary, we find that a reproducible relation does exist provided that a suitable measurement technique is used and the relevant parameters are well controlled. So far, our method for measuring the wavelength-hue relation has been applied successfully with luminance, adaptive state, and retinal eccentricity as variables. In this report we describe experiments in which retinal eccentricity was the variable. The method bears some similarity to one recently reported by Beare (*3*), although it was developed quite independently. It also shares common features with a method reported in a study by Thomson (*4*). A good discussion of the philosophical background of a method of this type has been given by Graham and Ratoosh (*5*).

Stimuli were circular, subtended a visual angle of 3 degrees, and were presented for 300 msec every 6 seconds. The visual field was otherwise dark excepting a tiny fixation point. Subjects were dark-adapted for 10 minutes before the fixation point was turned on and observations were begun. All stimuli were presented at 1000 trolands. Spectral stimuli were used in 10-nanometer steps from 440 to 660 nm, inclusive (17 nm total bandwidth), provided by a Bausch and Lomb grating monochromator equipped with a direct-reading microdial to allow fast and accurate adjustment of wavelength. The 23 wavelengths were presented in random order 20 times for each subject (5 times per experimental session) for each of the three experimental conditions, which differed only in the eccentricity of retinal stimulation to the temporal retina of the right eye. The eccentricities were: (i) 0 degrees (stimulus flashes directly fixated); (ii) 20 degrees, and (iii) 40 degrees. Maxwellian view was used; a telescopic alignment procedure was employed to insure that the image of the exit-slit of the monochromator, which acted as an optical artificial pupil, was exactly centered and focused in the center of the larger natural pupil.

The hue responses of the subjects were limited to the categories "red," "yellow," "green," and "blue." Subjects could give responses in zero, one, or two categories. These had the following significance: zero, only white present; single category response, unique hue present; double category response, mixed hue present, with the first response indicating the primary component. This information was communicated to the experimenter by means of four keys and an appropriate display which recorded information about response category and sequence. Additional responses of saturation estimates were required, and were signaled by the ringing of a bell. One ring indicated that an achromatic (white) component was perceived as being stronger than the chromatic component; two rings indicated that an achromatic component was present, but was perceived as being less strong than the chromatic component; no ring indicated that an achromatic component was only just detectable or was absent. Point values were assigned to each response according to the schedules shown in Table 1.

Table 1. Schedule of values assigned to responses.

Chromatic responses		Saturation responses	
Type of response	Point value assigned	Type of response	Point value assigned
Single	3, in category of the response	One ring, with no hue responses	3
Double	2, in category of the 1st response	One ring, with hue response(s)	2
	1, in category of the 2nd response	Two rings	1
None	0 in all categories	No ring	0

The result of this analysis is a set of five functions, one for each hue response category, and a fifth for the saturation estimates. These are shown graphically in Fig. 1. The appearance of the spectrum as revealed by this method may be illustrated by reference to Fig. 1 for the 0-degree condition for subject MN. This subject saw a reddish blue color at 440 nm which became progressively less reddish until unique blue was reached at 478 nm where the red and green

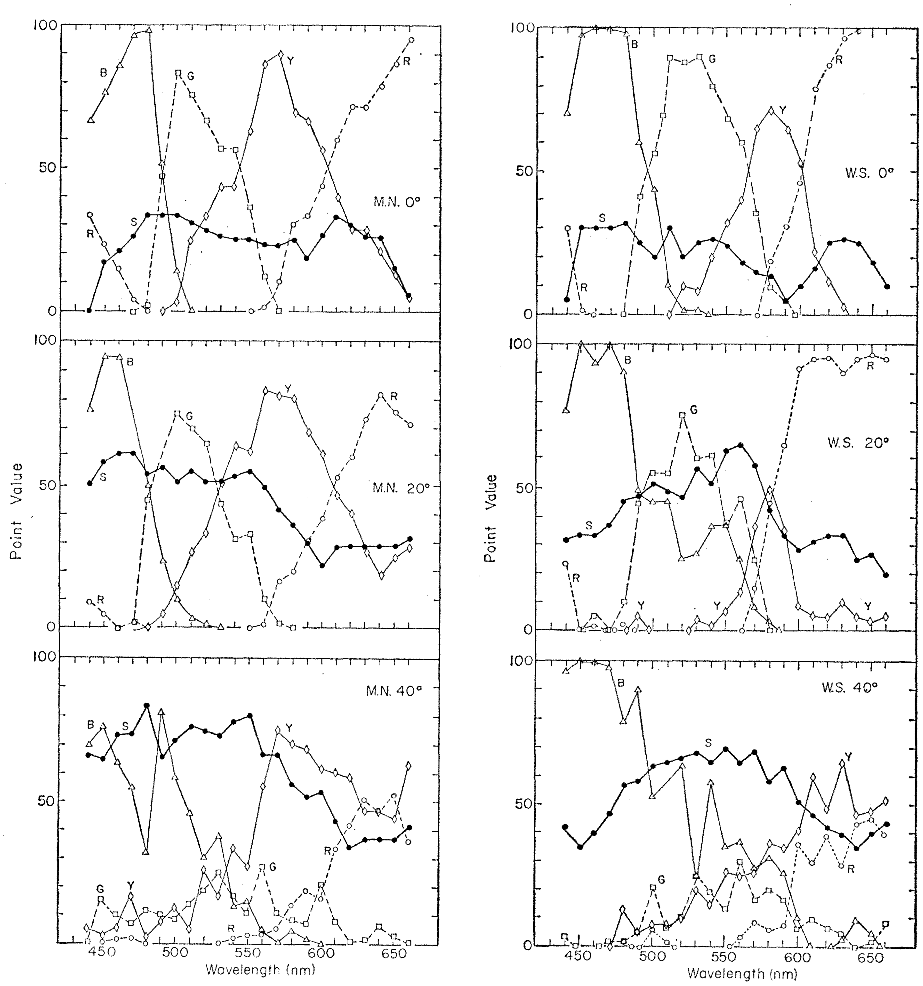

Fig. 1. Point-value functions for five categories of response for two subjects (MN and WS). Colors indicated by *B*, blue; *G*, green; *Y*, yellow; *R*, red. Saturation estimates indicated by *S*.

Table 2. Coefficients of correlation: within subjects and condition, and within subjects and between conditions.

Condition	Subject MN B	G	Y	R	S	Subject WS B	G	Y	R	S
	Within subjects and condition (split-half reliability, no correction)									
0°	.999	.999	.988	.999	.756	.996	.994	.994	.999	.696
20°	.998	.989	.966	.994	.721	.957	.964	.854	.719	.878
40°	.977	.376	.842	.967	.892	.908	.653	.834	.910	.810
	Within subjects and between conditions									
0°–20°	.988	.980	.980	.980	−.038	.974	.977	.926	.989	.133
20°–40°	.962	.718	.758	.956	.664	.919	.607	.725	.968	.908
0°–40°	.925	.740	.766	.945	.152	.925	.749	.287	.975	−.112

Table 3. Coefficients of correlation: between subjects and within conditions.

Subjects	Condition	B	G	Y	R	S
MN-WS	0°	.995	.962	.976	.996	.474
MN-WS	20°	.961	.951	.841	.984	.292
MN-WS	40°	.960	.940	.686	.954	.542

curves intersect. From 478 to 502 nm, the blues became progressively more greenish until unique green was reached at 502 nm where the yellow and blue curves intersect. A long region of yellowish greens and greenish yellows extended to unique yellow where the red and green curves cross at 565 nm. Yellow became progressively more reddish as the wavelength was further increased; red at 660 nm was still slightly yellowish.

Similar data were obtained with the other subject, although his unique wavelengths were somewhat different and he saw unique red at the extreme longwave end of the spectrum. As stimuli were moved into the periphery, little change in hue was noted at 20 degrees for subject MN, although an increasing desaturation was already quite evident. For WS, this desaturation was accompanied by increasing irregularity of the functions and some reduction in green responses that were replaced mainly by blue ones. At 40 degrees, it was quite clear that the color vision of both subjects had become strikingly deficient: blue and yellow responses predominated and saturation had become still less.

The results are compatible with those that have been reported with less precise methods (*1*, p. 73). Somewhere between 20 and 40 degrees there is a marked attenuation of red and green responses and a predominance of yellow and blue ones. This degeneration of peripheral color vision resembles that for deuteranomalous observers when compared to normals using central vision.

To assess the reliability of the method, split-half reliability coefficients of correlation were computed by repeatedly dividing the trials of the experiment (for a given subject and condition) randomly into two groups. For each of the response categories, summated point values (based on the 10 responses at each wavelength) were ordered from most to least for one of the two halves of the sample. This rank order was compared with that for the summated point values corresponding to the same wavelengths from the other half of the sample, and rank-difference coefficients of correlation were computed. In addition, correlations were computed between subjects for the same conditions, and between conditions for the same subjects. The correlations are shown in Table 2. From these one can conclude that: (i) the measurement of hue by our technique, for central fixation, is very reliable; (ii) reliability for hue decreases with increasing eccentricity of view; (iii) saturation measures are less reliable than hue measures for central viewing but become more reliable in peripheral viewing; (iv) the blue and red response categories yield the most reliable data; (v) saturation measures for central viewing are uncorrelated with those for peripheral viewing; (vi) the reliability between observers is quite high for hue, but rather low for saturation measures.

The results generally would seem to suggest a differential distribution of the various types of cones as a function of retinal location. On a five-cone theory (*6*) the results suggest that the density of green and red cones falls off with increasing eccentricity, more than does that for yellow and blue ones. Achromatic (white) cones increase in their relative density, accounting for the decreased saturation. Other theoretical interpretations are, of course, possible.

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Visual Experience in Infants: Decreased Attention to Familiar Patterns Relative to Novel Ones

Abstract. *A complex visual pattern presented for ten successive 1-minute exposure periods was fixated progressively less than comparable novel stimuli by infants 2 to 6 months old. This indicates the occurrence of recognition and habituation of visual responsiveness to specific patterns, and suggests that familiarization with the environment begins through visual exploration before more active exploration is possible.*

The eyes of the human infant are open, active, and sensitive to light soon after birth, thus providing the means for visual exploration of the environment. For early visual explorations to be important in the development of perception and behavior, it is further necessary that (i) the ocular movements and fixations be selective rather than random so that specific objects or areas of the environment can be looked at; (ii) what is looked at be seen with sufficient clarity that they may be distinguished from other objects or