time-of-day of melatonin treatment is important in determining the effects of this compound in pineal-intact hamsters. Single daily injections of melatonin (75 μg) did induce testicular atrophy when given to pinealectomized males at 1000 hours, whereas the same dosage had little effect when given at 2000 hours. In a previous study with intact males, single daily injections of 50 μg of melatonin administered at 1000 hours had no effect on testicular weight (*15*). These findings suggest that exogenous melatonin may be either potentiated or inhibited by the presence of the pineal (that is, endogenous melatonin?) depending on the time of injection.

Second, why did the same thrice-daily regimen of melatonin which was ineffective in pineal-intact males lead to acyclicity in intact females? In this regard it may be useful to enumerate two observations we have made on the effects of pinealectomy in females: (i) In some of our previous experiments a few females have become anovulatory following pinealectomy alone. (ii) In some experiments females that continued to cycle regularly following pinealectomy became anovulatory after daily injections of sesame oil. Similar problems have never been encountered in our experiments with male hamsters, nor were they encountered in the present study with females. Since maintenance of ovulatory cycles in this species requires regulation by a rhythmic neural center, whereas maintenance of functional testes may not (*16*), it might be that the female reproductive system is in general more subject to interference by systems related to rhythmicity (that is, the pineal) than is the reproductive system of the male. Nevertheless, even in the present experiments thrice-daily injections of melatonin in pinealectomized females appeared to block ovulatory cycles more rapidly then did the same treatment in intact females, providing some degree of analogy to the data for males.

Further studies are required to gain a better understanding of the role of the pineal in hamster reproduction. The finding that gonadal quiescence can be induced in pinealectomized hamsters by treatment with the pineal product, melatonin, should prove useful in further investigations of the role of this compound.

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A Phantom-Motion Aftereffect

Abstract. *Motion aftereffects, typically found to result only from localized retinal stimulation, were obtained within regions of the visual field that had not been stimulated by moving contours. "Phantom" stripes are seen moving through a physically homogeneous (empty) region of the visual field when vertical stripes move above and below that region. Immediately afterward, stationary stripes in the previously empty region appear to move in the opposite direction. This phantom-motion aftereffect provides a novel instance of the way global structure affects processes that have been assumed to be influenced only by simpler local spatial and temporal variables.*

After observers view a pattern of light and dark stripes moving steadily across some region of their field of view, a stationary pattern of similar orientation will appear to move in the opposite direction. This illusion of movement is called the waterfall illusion or the motion aftereffect; it has typically been shown to be restricted to that area of the visual field where the original movement occurred (*1, 2*).

We have found a motion aftereffect that is not restricted to the area of the visual field where the original movement occurred. Our design makes use of Tynan and Sekuler's finding (*3*) that segments of vertical stripes, moving horizontally, above and below a physically homogeneous region, create the impression that vertical stripes or contours are moving through the empty region (moving phantoms). After observing moving phantoms, we found that stationary stripes physically present in the previously empty region appear to move in the opposite direction—a phantom-motion aftereffect.

This phantom-motion aftereffect seems to depend on the presence of perceived motion in the empty region. Moving phantoms are not seen when the moving grating is present only above or only below the empty region, nor when the display is rearranged so that the empty region is vertically rather than horizontally oriented. Under these conditions, we found that reports of a motion aftereffect drop dramatically.

We used two grating patterns to produce the moving phantoms—a square wave grating (Fig. 1A) and an "illusory grating" (Fig. 1B) (*4*). The term "illusory grating" here refers to the stationary dark vertical stripes with apparently continuous contours that are seen as in front of a background of columns of X's (Fig. 1B). Both the real and the illusory gratings produced moving phantoms that in turn produced strong phantom-motion aftereffects (*5, 6*). In addition, when the contrast of the illusory grating is reversed so that black X's move against a white background, a striking amount of detail in the phantoms is observed: one sees not only phantom contours crossing the empty region, but also—dimly, but unmistakably—columns of X's in the empty region. A strong motion aftereffect is obtained in this case also.

Six different moving configurations were used as adapting patterns (Fig. 1, A through F). A square-wave grating (0.36

cycle per degree, space-averaged luminance 10.3 cd/m^2) (Fig. 1A) or an illusory grating drawn with lines of the same luminance as the lighted portions of the square wave (space-averaged luminance 2.1 cd/m^2) (Fig. 1B) both measuring 8.8° by 5.2° at 55 cm and moving from left to right horizontally at 2.8° per second (1 hertz) was presented either unobstructed across the entire screen, or it was interrupted by a 2.6° wide strip of black construction paper elongated either horizontally (8.8° long) (Fig. 1, C and D) or vertically (5.2° high) (Fig. 1, E and F). When the horizontally interrupted gratings moved across the screen, vivid moving phantoms appeared to be present in the empty region. These were moving at the same velocity and were of the same spatial frequency as the segments of grating above and below the empty region. When the moving gratings were vertically interrupted, none of the observers tested reported phantoms.

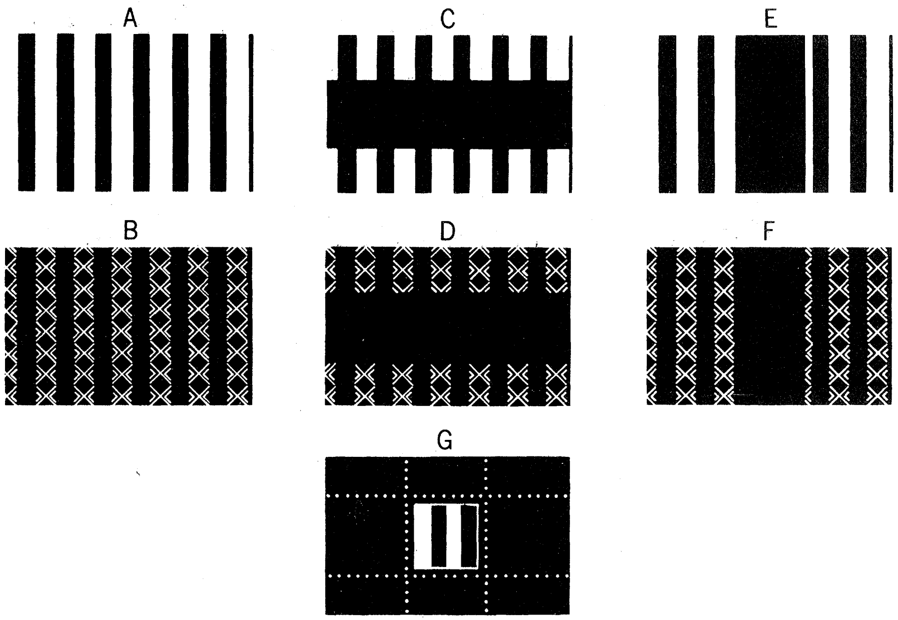

Fig. 1. Stimuli used in the experiment. For clarity, the frequency of bars is drawn twice the actual frequency used in the experiments. All other parts of the figures are to scale. On each block of trials, observers viewed one of the six adaptation patterns (A through F) moving steadily at 1 hertz for 2 minutes or 30 seconds. With C and D, vertical stripes (phantoms) are seen moving through the empty region when the pattern is made to move; with E and F, no such phantoms are reported. One second after the end of adaptation, the stationary test grating (G) was presented, and observers judged the extent to which it appeared to be moving. In experiment 2, only adaptation patterns A, C, and E were used, and the test patch was reduced in size and increased in spatial frequency. The dotted lines indicate the location of the horizontal and vertical empty regions.

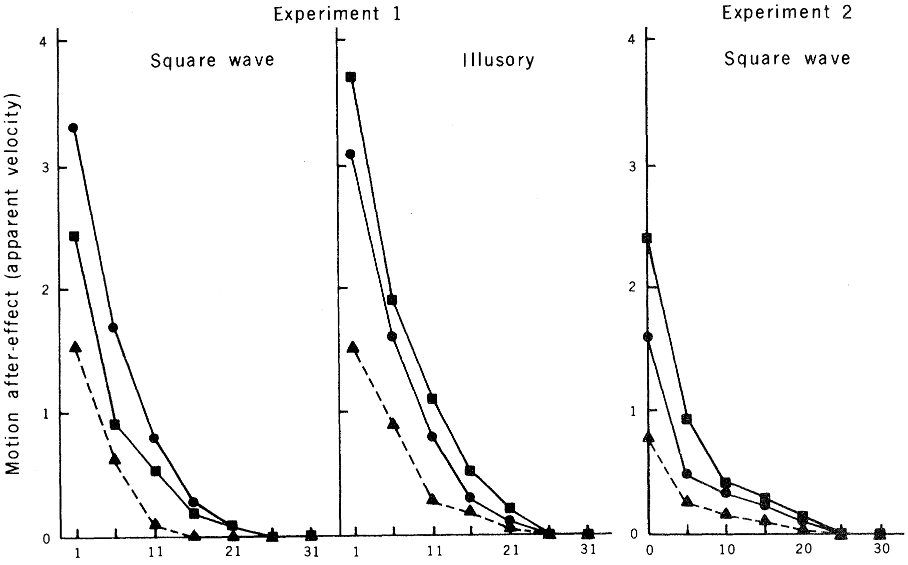

Fig. 2. Strength of the motion aftereffect as a function of the delay after offset of the moving adapting pattern. The three functions represent the motion aftereffect obtained in the usual way (full field, ■); the phantom-motion aftereffect (horizontally interrupted, ●); and the aftereffect obtained when there has been no perceived motion in the empty region (vertically interrupted, ▲). Each point shows the mean perceived velocity across six observers (12 trials per observer for each condition at each duration) in experiment 1 and across 11 observers (six trials per observer for each condition at each duration) in experiment 2.

The test pattern was a small stationary square wave of the same spatial frequency as the adapting square wave but of lower luminance (2 cd/m^2) (Fig. 1G). It measured 2.1° square, and was positioned so as to fall within both the horizontal and the vertical empty regions if they had been superimposed. The observer, head positioned by a chin rest, viewed a dim fixation dot made from luminous paint in the center of the field.

Six naive observers participated. One of the six adapting conditions (Fig. 1, A through F) was presented on each block of testing in the following order: C, D, B, F, A, E (*7*). Each block began with an initial 2-minute period of observing the motion. One second later, the test patch appeared. Observers estimated the strength of the motion aftereffect by assigning numbers proportional to the perceived velocity of the test patch. The estimations were made relative to a standard (called 10), which was the velocity of the full square-wave grating. After their initial estimation the test patch disappeared and then reappeared for 1 second once every 5 seconds until the aftereffect ceased. This procedure was then repeated for five shorter (30 seconds) adaptation periods. Blocks were separated by a few minutes in which only the fixation point was visible in the dimly illuminated field. These observations were repeated on a second day with the same observers and with the order of adapting conditions reversed.

Our main finding was that in the two conditions that give rise to moving phantoms (Fig. 1, C and D), all observers reported a strong motion aftereffect, whereas in the two conditions in which the grating was interrupted but moving phantoms are not seen (Fig. 1, E and F), they reported a weak or negligible aftereffect. Figure 2 compares the motion aftereffect obtained in the usual way [with the full-field gratings (Fig. 1, A and B)] with the phantom-motion aftereffect [obtained with horizontally interrupted gratings (Fig. 1, C and D)] and with the aftereffect obtained when there is no perceived motion in the empty region [vertically interrupted gratings (Fig. 1, E and F)] averaged for six observers at each delay after termination of the adapting patterns.

A four-way analysis of variance (7) showed all main and interaction effects except grating type (illusory versus square wave) to be significant at least at $P < .05$. When means were compared across subjects and durations for square and illusory patterns separately, the motion aftereffect was stronger when the square wave was horizontally interrupted (Fig. 1C) than when it was vertically interrupted (Fig. 1E) or uninterrupted (Fig. 1A) [$P < .01$, Duncan's multiple range test, two-sided (8)]. For the illusory grating (Fig. 1, B, D, and F), the motion aftereffect was stronger when it was horizontally interrupted (Fig. 1D) than when it was vertically interrupted (Fig. 1F) ($P < .01$) and strongest when it was uninterrupted (Fig. 1B) ($P < .05$).

Horizontal occlusion produces phantoms and a subsequent motion aftereffect only when a moving grating is present both above and below the empty region. In another experiment (6), we split the field and moved the bars from the left and right halves toward each other, meeting and disappearing at the center line. Again, when horizontally interrupted, phantoms and a strong phantom-motion aftereffect were obtained, this time with the subsequent stationary patch appearing to expand. However, when the top and bottom portions of these "colliding" gratings were presented in alternation, no phantoms were seen, and the motion aftereffect was significantly less ($P < .01$), even though this condition was presented for twice as long as the others.

The poor aftereffect generated by the full-field square wave was somewhat puzzling. It is possible that tracking eye movements, which can reduce or eliminate the motion aftereffect (2) were more extensive for the moving full-field square wave since it was more vivid than the moving phantoms or the moving illusory grating.

To test this possibility, we ran a second experiment using a more salient fixation dot—a red spot from a laser—reasoning that better cues to fixation might reduce eye movements. As part of a larger set of conditions in this second experiment, the test patch was decreased to 1.6° square, its spatial frequency was increased to 1.5 cycles per degree and it was presented immediately after the offset of adaptation. Eleven observers were tested for 1 day only. Adapting conditions were presented in a different randomly chosen order for each observer. No illusory gratings were tested. Otherwise, the procedure was the same as in the previous experiment. Under these new conditions of fixation, we found that the motion aftereffect for the full-field square wave increased (Fig. 2). Analysis of variance showed all main and interaction effects to be significant, and Duncan's multiple range test showed the three adaptation conditions to be significantly different from each other at least at $P < .05$.

It is not clear to us yet why horizontal interruption (Fig. 1, C and D) gives rise to moving phantoms while vertical interruption or horizontal occlusion without interruption (having the grating move only above or only below an empty region) does not. In the case of vertical interruption, however, perceived depth may be an important factor. Although the horizontal empty strip looks somewhat transparent and about in the same plane as the moving grating, the vertical empty strip looks opaque and well in front of the moving grating. (The perceived depth is striking: typically, observers estimate the grating to be 1.2 inches behind the strip.) When the empty region appears alternatively in two different planes of depth, the moving phantoms disappear and reappear. We have found, in pilot work, that trapezoidal figures surrounded on all sides by moving stripes will reverse in depth. When the trapezoid appears to be in front of the stripes, no moving phantoms are observed; when the trapezoid appears to be in the same plane or behind the stripes, moving phantoms appear.

The influence of apparent depth and other contextual relations on what have been considered relatively simple spatial and temporal variables may be more pervasive than has previously been thought. Depth-dependent changes in the apparent contrast of a patch of grating occur at retinal locations that were sheltered from the direct adaptational effects of a larger grating (9, 10). Words aid the perception of letters; coherent scenes aid the perception of objects (11). Even detection of simple line segments can be shown to be aided by a coherent, three-dimensional context (12). Our results provide a new example of an overall configuration's determining sensory consequences that cannot be predicted by considering relations over small regions of the visual field. Despite the lack of local retinal stimulation typically thought necessary for motion aftereffects, if there is an appropriate context, strong motion aftereffects occur.

Many investigators have assumed that context has little or no influence on initial encoding of simple spatial and temporal properties of a pattern (12). It is possible, however, that context exerts its influence at many different levels. Our results raise the possibility that those same mechanisms thought to be sensitive only to the relatively simple spatial and temporal properties of a pattern may also be involved in the computation of more complex relations in the visual scene (14).

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Gap Junctions: Their Presence and Necessity in Myometrium During Parturition

Abstract. *Thin sections of longitudinal and circular muscle of myometrium obtained from rats during pregnancy, at term, during delivery, and postpartum were quantitatively examined in the electron microscope. Gap junctions (low resistance pathways) were only present during or immediately prior to delivery and immediately postpartum. The absence of gap junctions during gestation may be necessary for maintenance of pregnancy, while their occurrence during parturition may lead to effective termination of pregnancy.*

Nexuses or gap junctions appear as a fusion of membranes into five or seven layers in ultrathin sections of tissue, or as aggregates of membrane particles when examined by freeze-fracture electron microscopy. They are thought to provide sites of low resistance to current flow between electrically excitable cells (*1*), including smooth muscle (*2*), and thus to be the pathway for conduction of action potentials or applied pulses (*1*). However, these junctions have not been demonstrated in several types of smooth muscle known to be electrically coupled (*3, 4*). In previous studies of the ultrastructure of rat myometria, we have not found even a single nexus or gap junction between smooth muscle cells in tissues from pregnant animals or those treated with estrogen or progesterone, or both (*3*). However, nexuses occurred frequently between the fibrocytes which surround the muscle bundles (*3*).

Recently, we found gap junctions between smooth muscle cells of the longitudinal and circular muscle layers of rat myometria that had been fixed for electron microscopy (*5*) during parturition (see Fig. 1). We have now quantitatively examined (*6*) the presence of gap junctions in thin sections of rat myometrium obtained during pregnancy, at term, during labor, and postpartum (Table 1).

There were no nexuses or gap junctions between muscle cells in either the longitudinal or circular muscle layers in tissues from animals fixed on approximately day 14 of gestation, or in any tissue from immature animals including animals injected with estrogen or progesterone, or both (Table 1). In all the tissues studied, there were many intermediate and close contacts between muscle cells, and frequent gap junctions between fibrocytes, as seen previously (*3, 4*).

In some tissues fixed at term (21 to 22 days) gap junctions were not observed in either the longitudinal or circular muscle layers (Table 1). However, in tissues from other animals gap junctions were present in both muscle layers. Gap junctions were always present in both muscle layers when they had been fixed during parturition (when 1 to 12 fetuses were delivered). Myometrial tissues from animals fixed 1 to 8 hours postpartum also always contained gap junctions. The numbers of gap junctions in animals delivering compared to animals not delivering or postpartum was insignificant ($P > .05$). The mean diameter of gap junctions in the muscle layers increased significantly in animals delivering ($P < .01$) or postpartum ($P < .05$) compared to animals at term. The corresponding areas of gap junctions relative to total membrane areas also increased (data not shown). There were no significant differences ($P > .05$) between mean lengths during delivery compared to postpartum.

That gap junctions are visible in thin sections between smooth muscle cells exclusively at term and during or following parturition has important implications for the maintenance and termination of pregnancy. Throughout the gestation period, the absence of gap junctions between contractile cells may be a major factor in the maintenance of pregnancy by preventing electrical communication between cells and coordinated contractions. The appearance of gap junctions between smooth muscle cells immediately prior to parturition may provide a large membrane area of low resistance allowing spread of electrical information between cells and terminating pregnancy by synchronizing uterine contractility for effective expulsion of the fetus.

We believe that gap junctions are present in tissues at term only when the animals have entered the final stages of gestation, that is, are ready to deliver. This hypothesis is supported by the finding that some animals reputedly at term cannot be induced to deliver by oxytocin while some can; only the latter have gap junctions in myometria. Since the time of onset of readiness to deliver (labor) of a particular animals varies, the occurrence of junctions will also vary in animals supposedly at term. This would explain our failure to find gap junctions in all animals reputedly "at term" (Table 1).

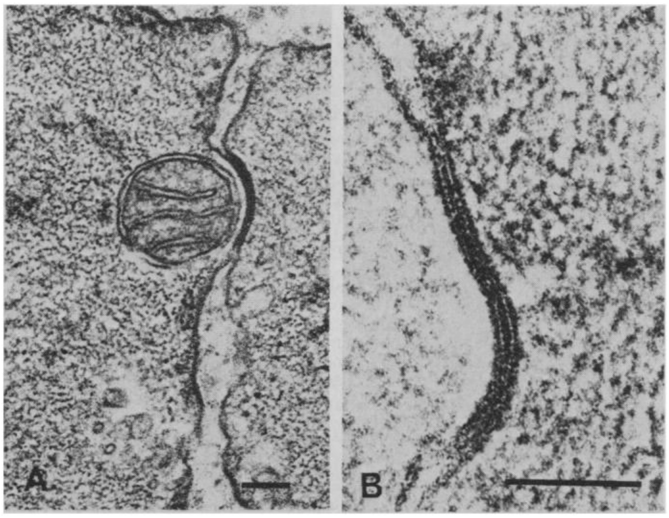

Fig. 1. (A) Electron micrograph of gap junction between two smooth muscle cells of the longitudinal muscle layer of rat myometrium fixed by intra-arterial perfusion during parturition (scale bar, 0.1 μm). (B) Gap junction between muscle cells from tissue similar to that in (A), as shown at higher magnification (scale bar, 0.1 μm).