On the whole, coelenterate gravity-detecting organs are restricted to the medusoid generations; until now only a few, aberrant polyps were known to have statocysts (such as the Narcomedusan polyps, *Halammohydra* and *Otohydra*[5]) and no polyps in the Hydroida were known to possess them[3]. (Salvini-Plawen[6] has described gonophore-like structures in *Siphonohydra adriatica* which may represent statocysts and B. Swedmark studied similar organs in *Euphysa aurata* (personal communication). In both cases, the probable statocysts seem similar to those in *Corymorpha*, although they are situated just below the proximal tentacle whorl. Probably all species of *Corymorpha* and the related genus *Branchiocerianthus* have statocysts in the holdfast filaments.) Statocysts are considered diagnostic in distinguishing between medusoid representatives of the Calyptoblastea, which possess statocysts, and those of the Gymnoblastea, which do not[3]. *Corymorpha* belongs to the suborder Gymnoblastea. The peculiar structure and morphological position of the statocyst suggest, however, that it may not be homologous with the ciliated[7] medusa organs which are known, and certainly does not fit into the coherent evolutionary pattern of medusoid statocysts carefully analysed by Horridge[1]. This statocyst resembles some of the endodermal gravity detecting organs of the primitive Trachylina except that those have sensory cilia[7].

This statocyst thus has a number of features which raise interesting zoological and cytological questions. It is ideal for developmental studies since all stages are ordered along the polyp base at all times[2]. Because it is so easily obtained and handled under conditions which allow extended high-magnification observations on active tissue, this statocyst may be a valuable sensory system for further experimental and cytological investigations.

This work was supported by a grant from the National Science Foundation and a National Institute of Health research career award.

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Received January 19, 1972.

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Cognitive Contours

IT is surprisingly easy to devise simple line figures which evoke marked illusory contours. Unlike the well known brightness contrast effects, these illusory contours can occur in regions far removed from regions of physical intensity difference; and they can be orientated at any angle to physically present contours. Fig. 1 is the figure described by Kanizsa[1]. An illusory triangle is observed whose apices are determined by the blank sectors of the three disks. The "created" object appears to have sharp contours which bound a large region of enhanced brightness.

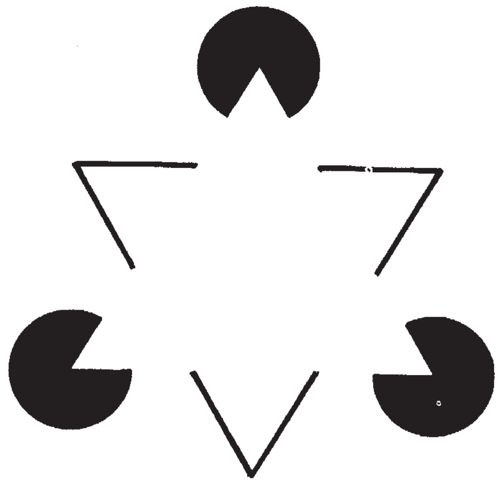


Fig. 1 Illusory triangle with apices in the blank sectors of the disks.

We can discover what features are necessary for producing this effect by removing parts of this figure (Fig. 2*a–c*). Three dots spaced as the apices of an equilateral triangle (Fig. 2*a*) give no created contours, although they are readily seen as indicating a triangle. The broken triangle (Fig. 2*b*) does not evoke the figure (except perhaps slightly after the effect has been observed in Fig. 1): but combining the equilaterally spaced dots with the broken triangle (Fig. 2*c*) does evoke the illusory object, though less markedly than with the sectored disks of Fig. 1.

The effect has particular theoretical interest, for it could be explained by two equally plausible but very different explanations, or paradigms to use T. S. Kuhn's[2] term. It might be described in physiological or in cognitive terms. The physiological paradigm would be satisfied with the supposition that feature detector cells of the striate cortex[3] are activated by the disk sectors (or less effectively by the dots) to give the

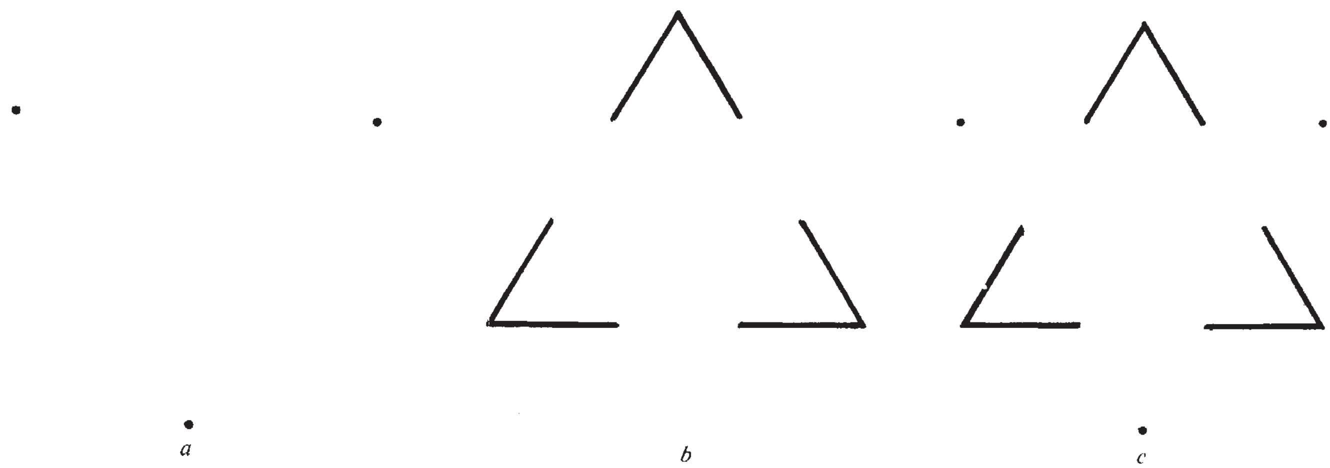


Fig. 2 *a*, Three dots which can be seen as indicating a triangle but produce no illusory contours. *b*, A broken triangle which again evokes no illusory image. *c*, A combination of the three dots in *a* and the broken triangle of *b*, which does evoke an illusory triangle.

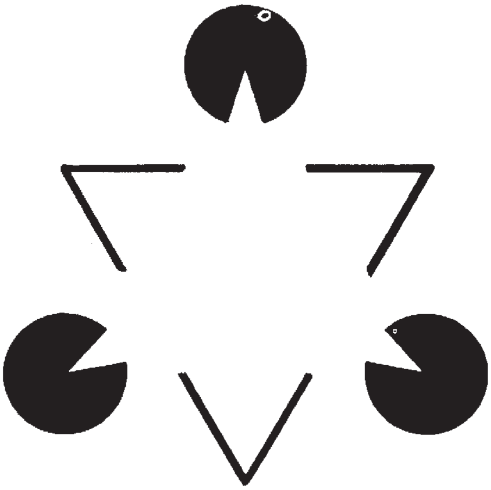


Fig. 3 Illusory triangle with curved contour.

appearance of continuous lines, though only their ends are given by stimulation. The cognitive paradigm of perception regards perceptions as hypotheses selected by sensory data, but going beyond available data, to give "object hypotheses"[4]. This paradigm would be satisfied by supposing that the illusory object is "postulated" as a perceptual hypothesis to account for the blank sectors and the breaks in the triangle. As these features are removed from the figure, the hypothesis becomes weaker, until the postulated masking object is no longer seen.

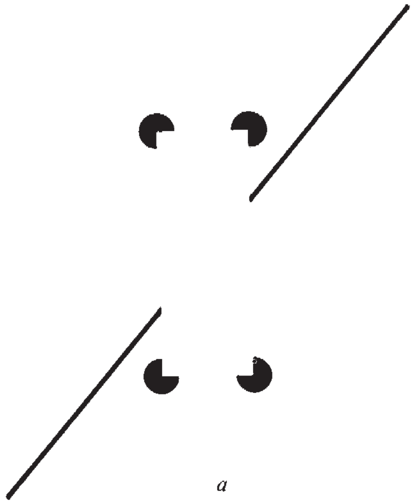
The effects also occur for stabilized retinal images (flash after-images) and so are not dependent on eye movements. By adopting the technique devised in 1899 by Witasek[5] of sharing parts of the figures between the two eyes, with a stereoscope, it is easy to show that the effect is not retinal in origin but must be after the level of binocular fusion; the effect holds when the sectored disks and the interrupted line triangle are viewed by separate eyes, and are stereoscopically fused. The illusory triangle may, on the second paradigm, be called a cognitive fiction—but is this notion science fiction?

By changing the angles of the disk sectors, so that they no longer meet by straight line interpolation, we find that the effect still occurs. The created form is now changed, to give interpolation with a curved fictional contour (Fig. 3). This new effect seems to increase the plausibility of the cognitive fiction notion, for it seems unlikely that "curved edge" detectors would be selected by the mis-aligned sectors. This might be answered by direct electrophysiology.

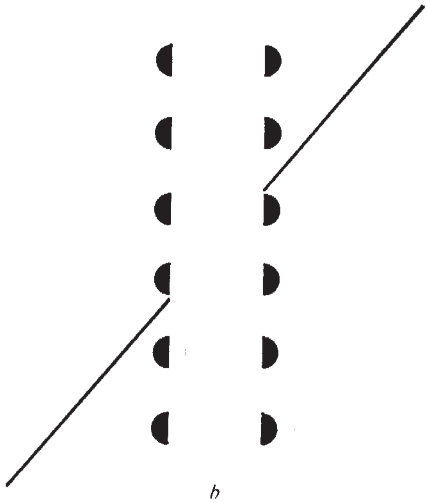
The black line on white background figures give a homogeneous whiter-than-white fictional region. The corresponding negative white line on black background gives a blacker-than-black region. The illusory intensity can be measured, in either case, with a reference light spot as in a matching photometer. Both the black and white illusory triangles are reported as appearing somewhat in front of the rest of the figures, which is compatible with the cognitive paradigm.

Viewed as flash after-images, the created regions change from black to white and vice versa whenever the after-image changes positive to negative, as for equivalent optical reversals of the display.

Not only contours but large homogeneous areas of different brightness are created—but are such areas of different brightness created by line detectors? Consider Fig. 2*b*. We have lines with gaps; but there is no observed difference in brightness between the inside and the outside of this triangle, and no contours between the gaps. So why should there be contours and a brightness difference with the illusory triangle, if both it and the normal line triangle are neurally signalled in the same way? The lack of contour in the gaps of Fig. 2*b* and the absence of enhanced brightness in such figures show that aligned features are not sufficient for producing these



a



b

Fig. 4 *a* and *b*, Poggendorff figures generated from "cognitive contours".

effects. What seems to be needed is a high probability of an over-lying object, giving gaps by masking. This would require processes of a logical sophistication beyond those believed to occur at the striate region. A description of processes postulating objects from sensory evidence seems to require concepts beyond those of classical physiology–cognitive concepts.

Finally, we find that at least some of the classical distortion illusions can be generated by these apparently cognitive contours and regions. Fig. 4*a* shows a kind of Poggendorff figure, in which the usual parallel lines are physically absent, but are generated by four sectored disks placed well away from the interrupted oblique figure. Figures such as Fig. 4*b* also evoke apparently cognitive contours, and they also produce distortion illusions. Such distortions in the absence of physical contours show that these illusions must, if the above interpretation is correct, have their origin at a cognitive level, which is consistent with a theory of the illusions already proposed[6].

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Received March 20, 1972.

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