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MICROWAVE DIATHERMY

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ABSTRACT

Application of heat to various parts of the body is a familiar and old method of medical treatment. When it was learned that alternating currents above a certain frequency did not stimulate living tissues but, instead, produced a beneficial type of heating, the technics of conventional diathermy and, later, short-wave diathermy became a part of medical technology. Scientific studies of these forms of diathermy showed that electrical currents of even higher frequencies would be desirable for supplying additional heat. These higher frequencies would have certain advantages over the short-wave and conventional diathermy because they could be focused more easily and directed at those areas where the heat was needed. It was not until microwave generators for use in radar were developed that outputs adequate for medical diathermy were available. Through the cooperation of the Raytheon Manufacturing Company we have procured the equipment necessary for studying the heating effects of microwaves. Any desired temperature may be obtained in certain living tissues. Caution must be taken when heating with microwaves in order to prevent the production of excessive temperatures.

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BINOCULAR SPACE PERCEPTION

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It has been estimated that over 80 per cent of our immediate contact with the world of objects about us comes through the sense of vision. So automatic are the visual processes that the majority of us are actually unaware of the eyes, unless trouble sets in and then we may become over-conscious of their existence.

The visual processes, which include not only the eye as a camera, but the neurological and the psychological systems by which light stimuli from objects in space finally emerge as an experience, are usually considered in the two categories: (1) The sensory aspects, which include the light sense and the space sense, and (2) the motor or muscular aspects, by which the eyes are coordinated and directed to the object of attention. In the visual act, all of these factors are operating.

In the space sense are the categories of direction and distance discrimination. We will be interested here in distance localization. We distinguish between relative distance or depth — the visual discrimination that one object is nearer than another, and absolute distance localization — the sense of the actual distance of objects from the observer. This last is a very complex process.

The clues to spatial localization are usually considered in two categories. (1) The *empirical* (*secondary* factors) clues are those that give rise to the depth discrimination or conception of distance based upon our past experience in relating the retinal image with actual association with objects in space and our concepts regarding these objects through all the senses and through reason. These clues are essentially monocular, though there are also binocular empirical clues. We might review the more important empirical clues as overlay, perspective, aerial perspective, light and shadows, parallax, height, and to a limited extent myosensory influences of the accommodation and convergence of the eyes. (2) The *primary* clues are those that are binocular and that result in stereoscopic perception.

Stereopsis arises essentially because each of the two eyes views the world of objects from two slightly different points of view, so that there are actually small differences in the retinal image patterns in the two eyes. These differences are appreciated by the brain and from these emerge an entirely new visual experience.

The phenomenon of stereopsis is unique and cannot be described adequately to a person who has not experienced or cannot experience it. We seem to actually "see" the empty space between objects, an aspect of relative depth perception that cannot be experienced in monocular vision. Stereopsis is said to be a specific sensation, directly arising from physiological stimuli in the same sense that the color red is an experience arising from the excitation of the retina by light of a particular wave length.

Now let us look at this a little more closely. If we have two objects, A and B, in space at different distances, the separation of the retinal images of these two points will be different in the two eyes. Mechanistically, we can say that the brain is able to appreciate the difference in the number of retinal elements between the stimulated points, so that B is seen farther away than A.

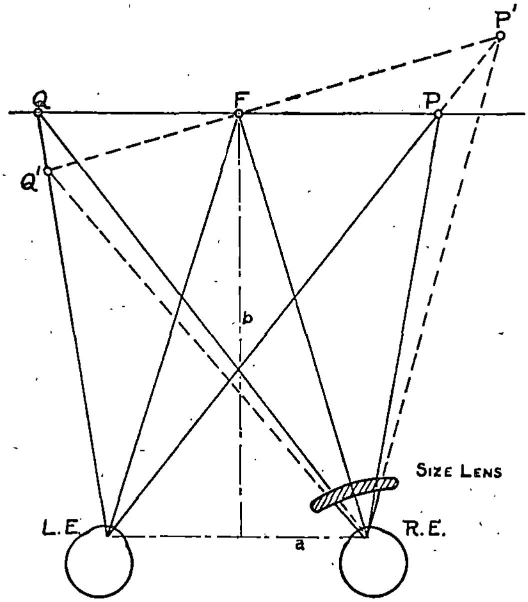
Geometrically, we can define the difference between the two images by the difference in the angles α_1 and α_2, $\eta = \alpha_2 - \alpha_1$, and η is called the geometrical disparity of the images of the two object points A and B.

Now the keenness with which the depth differences of A and B can be discriminated is called the stereoscopic acuity, and this is measured by the angular value of disparity. This angle, η, is of the order of 12 seconds of arc, but under certain favorable conditions may be smaller.

The actual discrimination of depth difference in terms of the disparity is more complicated, for it can be shown that the actual difference in depth (inches) for the same angular disparity varies as the square of the distance of one of the points. Other factors are therefore necessary to make this conception of depth possible — perhaps empirical factors. However, the greater the disparity the greater is the experience of depth difference.

It must be borne in mind that at least two points in space are necessary for a disparity to exist. With many points in the visual field, a disparity can be said to exist between the images of any two. Thus we could say that stereopsis should exist over the entire binocular visual field — and not be limited to a small region about the point of fixation.

That stereopsis actually leads to a complete spatial localization can be demonstrated by placing a lens before one eye which changes the magnification of the retinal image. A special type of lens is preferred for this in order that the retinal image will not be blurred. This lens acts like a small telescope and is essentially an afocal lens, in that the image seen through it remains substantially in the same plane in space as does the object. The magnification will depend upon the power of the front surface and the thickness of the lens. Small magnifications of less than 5 per cent only are required. For an adequate demonstration of the effect on stereoscopic vision this lens should magnify only in one meridian, and hence its surfaces instead of being spherical are cylindrical with axes parallel.



The figure shows how the lens placed before one eye to magnify the retinal image in the horizontal meridian only causes a false localization of space. All objects in space are accordingly affected. Those to the right appear farther away, those to the left appear nearer. The floor appears to slant left side up, right side down. Objects also appear distorted, and their apparent sizes change. To experience this false localization best, it is necessary to find surroundings where the empirical factors to spatial localization are not strong. The visual space can also be distorted when the lens is placed so as to magnify the retinal image in the vertical meridian, or meridional lenses can also be placed at symmetrically oblique meridians before the two eyes to give still another type of distorted space as perceived in stereoscopic vision. An overall magnifying lens before one eye, however, produced little or no spatial distortion because of the induced size effect phenomenon.

We have recently shown that with one exception these spatial distortions can be predicted on the basis of the geometry involved, the optics of the lens and the concept of image disparity.

The point of this rather over-simplified discussion is to show that stereoscopic spatial localization is effective as an entity over the entire binocular visual field and is not alone concerned with discrimination of differences in depth in the region about the fixation point.

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MICROWAVE DEMONSTRATOR

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ABSTRACT

The oscillator we use was built from surplus military radar cavities made available by General Electric for distribution to educational institutions. Complete instructions for conversion were prepared by Dr. C. L. Andrews, who did considerable work with this type of equipment while he was with General Electric. The cavity with a 2C40 "lighthouse" tube is a continuous wave oscillator with waves of 11 to 13 cm. The plate potential may be 250 volts a.c. or d.c. If a.c. potential is used, the radiated wave will be modulated with 60 cycles. We are using a transformer which will give either 250 or 295 volts. The latter is used for short periods only or the cavity becomes too warm. It serves to increase our output enough to give us better results on some demonstrations. The reflector we use was one from an old spotlight with the dipole set at the point of focus.

To study the field of radiation, we have an intensity meter. This consists of a microammeter equipped with a quarter-wave dipole antenna and a fixed silicon crystal detector. For accessories we use a double antenna arrangement for Young's experiment, Fresnel zone plates to show constructive interference, a polarizing grille, and a wave guide. The latter can be easily constructed by using small