RETINAL EXCITATION OF CORTICAL ORIGIN IN VISUAL HALLUCINATION.

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The question to be considered under this title is: Does ideational activity of the cerebral cortex ever induce centrifugal excitation of sensory end-organs through their afferent sensory nerves, and thus lead to the sense of objectivity, or projection, that is the characteristic feature of hallucination?

For the sake of clearness, consideration of the question is confined to the sense of sight.

Quite commonly hallucination is made to include all phantasms that have no other than a subjective foundation; but to answer the present question, a stricter differentiation of subjective phantasms than the common definition implies, is necessary. Phantasms having a peripheral origin, though without objective, or external, cause, must be distinguished from those having a central origin. Following Emminghaus,¹ the former may be allowed to fall within the term *illusion*; and hallucination may be made to include only those phantasms that have a purely central origin.

In answer to the question of the occurrence of peripheral sensory excitation of central origin, authorities are not in accord, but the voice of affirmation is much stronger than that of negation.

The belief ordinarily entertained is that in an hallucination there is a backward nervous "current," from center to periphery, which perfects the sense of its objectivity.

The prevalent idea is an assumption; for, in the nature of the case, such a reverse "current" cannot be proved to occur; and we may therefore examine the ground upon which this assumption rests, and make a theoretical application of the principle it involves.

Emminghaus² says: "The assumption that in hallucination there is a nervous excitation that advances from center to periphery, rests essentially upon the fact that under certain circumstances, visual phantasms *change their location*."

Krafft Ebing³ states that with perfection of objective projection of an hallucinatory image, there is probably secondary excitation of the organs of sense involved.

Wundt⁴ also holds to this view, basing his opinion upon the statement that visual hallucinatory images may excite after-images, as well as upon the fact that the phantasms move with movements of the eyes.

Sir David Brewster⁵ believed that all hallucinations involved the appropriate sensory organs. Esquirol⁶ promulgated the theory of the purely central origin and nature of hallucinations.

While D. Hack Tuke⁷ thinks that cortical activity is in itself sufficient to produce hallucination, he still allows that the end-organs may be involved secondarily in some cases; and as criteria for the determination of secondary (?) retinal excitation he states as follows:

"If visual hallucinations present the same phenomena as those observed in luminous after-images, they may be regarded as involving the retina."

The phenomena referred to are that the phantasm cannot be artificially doubled; that it covers real objects; and that it moves with the motion of the eye. These phenomena include all the evidence of secondary retinal excitation that other authorities mentioned adduce.

But in visual hallucinations all these phenomena might be present without involvement of the retina at all; that is, they do not demonstrate that the retina is involved. For the visualization of a mental image not involving the retina would necessarily be projected in the immediate field of vision and cover objects in that field, or be fused with them. Thus, while these tests will demonstrate whether a visual phantasm is of subjective or objective origin, in the nature of the case it cannot prove involvement of the retina, or at least that retinal excitation is of central origin, when the phenomenon is thus demonstrated to be subjective.

With primary subjective retinal excitation and secondary elaboration of the impression (illusion), we are not dealing here; phenomena of this nature are in perfect harmony with the physiological process of visual perception. It is only the possibility of the reverse process, with the primary stimulus having a central origin, that is here called in question.

Centrifugal excitation of the retina in visual hallucination is not a *sine qua non*. There is abundant evidence to prove that mental images undergo objective projection in the absence of the sense organs that would be involved. Where visual hallucinations have occurred with atrophied optic nerves, if centrifugal excitation took place the element of objectivity must have been supplied without the aid of the retina.

But let it be assumed, that a reverse stimulation occurs and affords the elements of distinctness and objectivity essential in hallucination. For the sake of clearness and simplicity, let it be assumed that the mental image is to be projected visually and involve one retina; that the mental image is that of an object of two dimensions of a given size situated a certain distance from the eye. Then, in accordance with the assumed premises, if this image be projected with an accompaniment of corresponding retinal excitation which assists in the induction of the sense of its distinctness, the retinal area excited must be exactly that area that would be stimulated if the actual figure were before the eye under the conditions of distance and dimension imposed.

In the absence of knowledge of any nervous mechanism designed to select nerve-fibres which shall convey the nervous excitation back to the retina, we may allow that cortical activity attending consciousness of the image in itself conditions such a selection of nerve-fibres as must convey to the retina excitation that distributes the stimulation there in the form of the image. In order that the image thus formed on the retina shall add distinctness to the mental image, it must, in the whole of its dimensions, be confined to the very limited area of the retina in which, as is well known, distinct vision is possible—the fovea centralis. For if the secondary retinal image were indistinct, as it would be, if disposed upon an indifferent retinal area it could not reinforce the distinctness of the mental image. If, for the

¹ Psychopathologie.

² Op. cit., pp. 156, 157.

³ Lehrbuch der Psychiatrie, dritte Aufl., p. 114.

⁴ Physiologische Psychologie, Bd. ii, pp. 423, 433.

⁵ Letters on Natural Magic.

⁶ Maladies Mentales.

⁷ Hallucinations and the Subjective Sensations of the Sane, Brain, Vol. xi, p. 41.

sake of distinctness, the retinal image must be confined to a certain limited area, and the necessity for this seems clear, then its objective projection would necessarily be like the projection of the distinct image on the retina when the eye is at rest. The apparent visual angle would be all that could assist in the projection of the secondary retinal image. But the visual angle in itself has no determining effect in developing an idea of space; and therefore in the assumed case it could alone have no effect in determining definite projection of the assumed centrifugally conditioned image. Therefore, the secondary retinal image, even though it correspond in form with the primary mental image, could not in itself condition an objective projection in harmony with the idea of objectivity with which the image is present in consciousness, and therefore, for distinctness of projection of the mental image, the aid of some other element than that supplied by the secondary retinal image would be required.

Now, let the hypothesis be complicated by bringing binocular vision into consideration; let the assumed mental image effect both retinae. Then it must be assumed that the area of stimulation, in one retina, is physiologically correlated with the stimulated area of the other, in order to have perception of a single image. But in this instance, as in the preceding, the projection that results in that the images are identical, will be subject to the same conditions as obtained under the preceding assumption.

To still further complicate the matter, let the image, to be projected, be inverted with the third dimension.

An object having three dimensions seen in binocular vision impresses simultaneous images on each retina that are not identical, save when the object is seen in distant vision; in fact, an object of three dimensions viewed with convergence of the visual axes, may impress images on the retinae that differ almost absolutely from each other. It is largely owing to the disparity of these simultaneous images of one object on two co-related retinae, which undergo subjective fusion into one image, that the idea of the third dimension of the object is derived. Now, in the assumption of the reverse stimulation of the retinae by a mental image of an object of three dimensions, it would not suit the purpose of the assumed secondary excitation were this single mental picture to be photographed identically on each retina; for then the objective projection of them would not possess that want of identity necessary for the induction of the sense of its third dimension. But a single mental image cannot be consciously resolved into two images from which the former might be derived, without having consciousness of two images successively; and it is therefore impossible to conceive, when the mental image is derived from two or more aspects of an object, how consciousness of the single image could condition a centrifugal excitation of co-related retinae by disparate images. Here again the centrifugal retinal excitation would necessarily lack that determinateness to supply which it is assumed.

The fact is that all our reproduced mental images are complex simultaneous reproductions of a series of simple visual preceptions that were originally received in series and fused by association. The limitation of visual perception conditioned by retinal structure and function is in extreme contrast with the almost unlimited power of simultaneous repro-

duction in combination of serial, simple perceptions in memory. In the very nature of the case, then, a complex mental image could not condition a centrifugal excitation that is objectively impossible; the retinal excitation, were it to occur, would necessarily be simple, or at most but a reproduction of some element of the mental image. Thus exact simultaneous correspondence between the mental image and any secondarily induced retinal image, is impossible.

Under all circumstances, then, under which we can theoretically conceive a mental image as exciting a reverse "current" to the retina, there would be more or less disparity between the mental image and the resulting sensory excitation; that is, that additional quality with which secondary sensory excitation is presumed to supply the primary mental image for the sake of distinctness, is found to be so indeterminate, that if it were to occur it could only confuse the original mental image.

But if secondary excitation of the retina could not intensify the quality of distinctness in a mental picture, might it not, nevertheless, add the element necessary for its objective projection? Let it be assumed that it does. Then any visual sensation that does not correspond with the mental image present in consciousness is capable of adding the sense of objectivity: any elementary visual sensation, one as well as another, would serve the same purpose.

If this be true, what need is there to assume that there is any reverse sensory stimulation at all? The retina, like all sensory organs, is almost constantly subject to inadequate subjective stimuli, and any or all of these might aid as efficiently in inducing a sense of objectivity as an indeterminate stimulus travelling backwards.

Discussion.

Dr. Wm. Fuller, Grand Rapids Mich.:—Dr. Chaddock's paper reminds me of a case that came under my observation, in which a man was able to see two images with one eye—monocular diplopia. When both eyes were open he saw two images of the same object, a true one and another smaller one nearer to him, and placed a little above and to the right. When the left eye was closed both images were seen in the same position, but when the right eye was closed the true image only remained. With the right eye closed he could place his finger on the head of a pin at the distance of two or three feet from the eye, but with the left eye closed or with both eyes open he was unable to do so, on account of the uncertainty of the position of the object. There was paresis of the left extremities, especially of the arm. The man had received a severe blow on the right side of the head, over the coronal suture, about a month before, at which time he was unconscious for several hours. The diplopia was observed immediately upon the recovery of consciousness, and has remained up to the time of examination. In walking he lifts his feet high, as the floor appears to him to be elevated before him. The defect in vision was corrected by prisms and disappeared after a short time, about two weeks.

Dr. Welsh, of Grand Rapids, saw the case with me and reported: Distant vision, right eye, 20-30; distant vision, left eye, 20-30. Ophthalmoscope showed a normal fundus.

His opinion was that the false image was the relic of a mental impression which was forgotten after correction had been maintained for a sufficient period to efface it. The case is an interesting one, and I would like some gentleman present to give a satisfactory explanation of it.

The Chairman:—I have not seen a case like it, and am not aware that there is such a case described in literature.

Dr. James Taylor, of London, Eng., stated that such a case was reported in the Transactions of the Ophthalmological Society of Great Britain.

Dr. L. Bremer, of St. Louis, Mo., had seen two cases of monocular diplopia, one case being due to a cerebellar tumor. A number of other physicians saw this case.

Dr. J. H. Kellogg, of Battle Creek, Mich., also reported a case of monocular diplopia, and stated that ophthalmolo-

gists believe that such cases are due to irregularities of the cornea or crystalline lens. He had a case in which a man declared that he saw three images at one time with one eye, but these images were not always present. The speaker found only two objects present.

Dr. L. Bremer stated that the eyes of the individual whose case he had reported had been examined by a competent ophthalmologist and nothing had been found to throw light on the condition. The whole question of cortical vision is still very much mixed.

Dr. C. K. Mills, of Philadelphia, said the separation of the optical or cortical field of vision by some lesion might possibly furnish an explanation in some cases, but we have no definite knowledge in regard to these cases.

The Chairman:—I do not believe it is possible for us to have a diplopia through an affection of the cornea or lens. Displacements and disturbances of the lens are exceedingly common; but so far as I know, the condition under consideration is a very rare one.

EARLY NATIONAL LEGISLATION ON THE SUBJECT OF QUARANTINE.

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The approach of cholera again to our shores, will awaken a new interest in the character, management and efficiency of our quarantine defences against foreign pestilences. The crucial test which is now applied to our present system of State quarantines, and the evidences of their total inadequacy to meet a great emergency, will doubtless renew with great vigor the popular agitation in favor of a National quarantine organization. As a contribution to the discussion of that subject the following facts in regard to the efforts made in the first sessions of Congress may prove of interest, if not of permanent value.

On the organization of the Federal Government, in 1789, several of the sea-board States had quarantine laws and regulations of more or less efficiency. In most of these States the laws were originally adopted by the colonial governments, and in some they had been in effect for nearly a century. South Carolina enacted a quarantine law as early as 1698, Pennsylvania in 1699, Rhode Island in 1711, New Hampshire in 1714, New York in 1758. These early laws were chiefly designed to prevent the importation of small-pox, though yellow fever and ship or typhus fever had attracted attention as diseases capable of transportation. Yellow fever had several times, but at long intervals, been epidemic in sea-board towns having a large commerce with the West Indies, as at Boston in 1693; Philadelphia in 1699, 1741, 1747, 1762; New York, 1702, 1743; Charleston, 1699. But it did not attract attention nor excite great public alarm until commerce with the West Indies, after the Revolutionary war, was fully established. From 1762 to 1791 the country was entirely free from yellow fever. This immunity has been attributed to the parliamentary acts known as the "commercial monopoly," and the war of the Revolution, which prevented all direct commerce with the West India ports and the United States. With the restoration of an active commerce with the West Indies yellow fever again began to make its appearance in those ports where this trade was most active. The first outbreak occurred in New York in 1791, in the West India shipping, and the pestilence proved very severe and fatal, and caused great public alarm. In 1793 it appeared in Philadelphia, and was then universally attributed to the shipping from the West

Indies. The pestilence now began to excite public alarm, especially in neighboring cities having personal and commercial intercourse with Philadelphia. New York, Chestertown, Baltimore, and Annapolis took active measures, and finally established rigid land quarantines against Philadelphia. In 1794 it appeared in New York, Philadelphia, and Baltimore, and the public excitement was so great that there was a renewal of the land quarantines in various sections. In 1795 the fever again prevailed at New York and Norfolk, Va., and vigorous measures of protection were discussed and adopted by the authorities of other exposed towns. It would be impossible at this distant period to properly estimate the current events of the time when yellow fever first became widely epidemic at the close of the last century, had we not passed through a similar epidemic in 1878-'79. Then, as now, the disease was regarded as contagious and infectious, and all of the precautionary measures were designed to prevent the contact of the sick with the well. Maritime and land quarantines were established, and the latter was enforced with the shotgun. In most of the details the measures of prevention in 1793 were the same as in 1878, more than three-quarters of a century later.

In order to understand the first act of Congress relating to quarantine it will be necessary to refer to the exciting events of that period. The following extracts from the papers of that date, kindly furnished by Dr. J. M. Toner, of Washington, reveal the intense excitement of the communities living in immediate communication with the centers of infection.

In 1793 the citizen of "Chestertown," Pa., held a public meeting. Their first resolve was:

"It appearing to this meeting, from the information they have received, that the said disorder (an infectious disorder which at present prevails in the city of Philadelphia) has extended itself from Philadelphia to Trenton, Princetown, Woodbridge, and Elizabethtown, on the post-road to New York, it is the opinion of the meeting that the same has been occasioned by the stages passing through those places."

"2d. *Resolved*, therefore, That it is necessary and proper for the welfare of the inhabitants of this town that the stages should not pass through this place, and that notice of this resolution be given to the stage owner; and further, that if the said owner should refuse to comply with this resolution, that then the chairman shall call a second meeting to deliberate on and adopt such measures as self-preservation may in that case dictate and justify."

The mayor of New York, Richard Varick, issued a circular to the profession of that city, September 11, 1793, stating that "Great apprehensions are entertained by many of our fellow-citizens that, notwithstanding every prudent and legal precaution, the contagion of that distressing infectious disorder may be brought into this city by means of the open intercourse between the two cities, which cannot be lawfully interrupted by any power in this State." He informed them that a hospital had been provided for the sick, and requested reports in writing of every person arriving from Philadelphia who should be taken sick.

On the 17th of September, it appears that

"The corporation, at the request of citizens of New York, have come to a resolution absolutely to prevent all intercourse between this city and the city of Philadelphia, and for this purpose guards are set at the different landings with orders to send back every person coming from Philadelphia to this city; and if any persons shall be discovered to have arrived in this city after this date, it is the resolution of the citizens immediately to send them back."

On the 12th of September of the same year the