the primary position to a point situated obliquely above or below, the eye moves first on its perpendicular, and then on its horizontal axis, the latter movement will be accompanied by torsion.

From this movement of torsion are to be distinguished two changes in the relative position of the retina. The first is a deviation of the perpendicular meridian of the retina from the objective perpendicular. This failure of the perpendicular meridian of the retina to correspond to the objective may be designated (*Aberration*) aberration. It may appear, as, for example, when the eye is moved obliquely from the primary position, even though no torsion has taken place. Finally, if in any position of the eye the planes of regard and of the retinal horizon do not coincide, the angle between them may be called the angle of (*Raddrehung*) rotation. The term torsion applies, then, to actual movement, while the terms aberration and rotation refer to angles of position.

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Zur Theorie der räumlichen Gesichtswahrnehmungen. Von W. WUNDT. Philosophische Studien, Vol. 14, pp. 1-118.

The question as to the origin of the spatial character of sight is here treated in an article which is indeed attractive and certain to stimulate considerable discussion. The mode of procedure is, in the main, strictly empirical; the author devotes himself to a leisurely review of certain facts which seem to him to put us in a position where a decisive answer can be given to the problem in hand.

As part of the data on which his conclusions are based, Wundt gives the history of his own remarkable case of retinal disturbance, due to a diseased condition of the underlying tissues (*choroiditis disseminata*). Irregular displacements of the retinal elements occurred and were accompanied by an apparent distortion of objects in view. In time, however, this distortion passed away, and while, as Wundt points out, it is not impossible that the displaced parts may have returned to their original positions, this seems, under the circumstances, highly improbable. The indications were that these parts remained displaced and finally became functionally adapted to their new positions. For it is evident from other cases, where a persistent refractive instead of a retinal disturbance has existed, that a functional readjustment can take place in the retina, and the earlier irregularity in the appearance of things entirely disappear. There is, therefore, no hard and fast spatial meaning attached to a particular retinal element;

and since an element can thus acquire a new spatial meaning, there is every reason to suppose that its primary local signification was also acquired and not received as a native endowment.

The more important experiments on the perception of depth are next discussed, with especial emphasis on the evidence that these perceptions arise, not from the will nor from the differences in the two retinal impressions, but from a complex of extra-retinal sensations originating chiefly in the sockets of the eyes, although strictly muscular sensations may play an important subordinate rôle.

But by far the weightiest facts, the author believes, are furnished by the so-called geometric optical illusions. The well-known deceptions in the length and direction of lines show the influence of the eyes' motor mechanism in our space-perceptions—an influence still more strikingly revealed in those ambiguous outlines, such as Schroeder's stair-figure, which show a reversible perspective. In this latter class of illusions, according to the author, the actual relief which the outline assumes depends solely on the point of fixation or (if we look, not fixedly, but glancing) upon the direction in which our eyes move along the lines; if one fixes or moves his eyes thus and so, the figure appears in a certain relief; if he does otherwise, the perspective is reversed. The slight variation in the position or movement of the eye here makes the perception take on an entirely different appearance. This, Wundt feels, is most significant for a theory of spatial vision.

After examining this evidence the author concludes that the motives for visual localization are neither of retinal origin exclusively nor merely from the tactual and muscular function of the eyes, but are to be found in an intimate fusion of sensations from both of these sources; each 'local sign' is a composite of elements coming from both the retina and the tactual and muscular parts. This he calls the 'theory of complex local signs.' In stating his theory Wundt takes a stand, moreover, against nativism, inasmuch as the spatial aspect of vision is a gradual development under definite empirical conditions. At the same time, he objects to calling his own an empiristic view, because space, psychologically speaking, cannot justly be said to result from 'experience.' The spatial quality in our mental life is certainly a product, but a product which must precede experience in any proper sense, and, therefore, cannot flow from it. He prefers the term 'genetic' to express this side of his doctrine.

The facts which Professor Wundt brings out seem sufficient to convince one that extra-retinal sensations have an influence on the

total visual result. During the reading one feels that this has been so abundantly supported that more ought to have been said for the other side of the theory, namely, that each local sign has also a retinal factor in its composition. The author has nearly left us to our own resources in regard to this, whereas at the present day it is exactly here that doubts are most ready to assail.

This uneven distribution of the author's forces is perhaps best to be explained by the fact that his object seems to have been, not so much to marshal all the data which make for his view, as to point out the significance of certain interesting phenomena, more especially the illusions of reversible perspective. Whether these illusions may really be interpreted as Wundt believes, can hardly be decided without more extended experiment. As far as my own observations go, the sudden reversals do not follow the simple laws of ocular position and movement which the author states. Rhythmic alterations of relief occur in my case when the point of fixation has apparently remained unmoved, and even when—as in observing not the figure itself, but its after-image, the diagram which Wundt counts the best having first been retraced white on a black ground, and exposed to a strong light—any movement of the fixation point, at least with reference to the image itself, was impossible. Likewise, repeated movements of the eyes along a given line do not in my case give constant results. If such irregularities are at all frequent they will certainly be an obstacle to our drawing from these illusions the inferences Wundt does.

The subordinate importance which Professor Wundt gives to sensations from the eye-muscles as compared with those produced by pressure and friction in the sensitive sockets will be welcomed by many who do not feel that *Muskelempfindungen* explain all things.

As for the general theory of visual extension proposed, it is perhaps the one which on the whole seems best to accord with the known facts. One can hardly say, however, that the facts adduced are absolutely coercive against the opposing views that the spatial perception may under certain circumstances be mediated by local signs which are not 'complex' in Wundt's sense. All we can say is that in certain perceptions the motor as well as the purely retinal impression is psychically operative. But that in every instance both factors are absolutely indispensable may perhaps still be counted an open question.

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