

bare idea 'that it is,' without the possibility of knowledge as to 'what it is.' Shades of the great founder of critical agnosticism! And yet I have been studying carefully over and over again the 'Critique of Pure Reason' for years and with scores of keen and critical minds as pupils and co-workers, and have never discovered my agreement on this particular doctrine with the sage of Königsberg. But since I can scarcely ask Professor Fullerton to read again the 'Philosophy of Mind,' where I have, as clearly as language can and so often as really to run great conscious risk of wearying my readers, tested and rejected the Kantian view, I know nothing better to suggest for him than a revised study of Kant. Perhaps this will lead him to discover unlimited chances for obscurity and inconsistency in his own attempt to place a writer who affirms that *we do know reality*, beyond all power of sceptical idealism or agnostic positivism to shake the foundations of such knowledge, in every act of self-knowledge, and that *all knowledge is, quoad knowledge, essentially transcendent*, agree with the great author of the 'Critique of Pure Reason,' who taught on all these points precisely the contrary view.

Much more might be said about Professor Fullerton's manner of treating those whose names and opinions he is wont to handle with such effective appearance of grace and ease. But I prefer to leave sword-play for the most part to men who like it and who really think it leads to truth, and to content myself with the humbler and less impressive use of trowel and spade.

GEORGE TRUMBULL LADD.

YALE UNIVERSITY.

UPRIGHT VISION AND THE RETINAL IMAGE.

Professor Hyslop's recent objection to my article on 'Vision without Inversion of the Retinal Image,' in the November number of this REVIEW, is a welcome criticism of the bearing of my experiments, even though the form in which he has seen fit to express his objection is, perhaps, needlessly brusque. He says, in substance, that I have missed the real problem of upright vision in taking it as a problem of the harmonious interorganization of motor, tactual and visual experience, and that the real problem is an exclusively visual one. According to his view, the question of upright vision is: How do apparent objects get a spatial position inverse to that which they have in the retinal image? And since my article, to his mind, shows clearly that during the experiment the position of apparent objects was

still the reverse of their position in the retinal image, my experiment has nothing to do with the problem of upright vision.

I am glad that Professor Hyslop has taken the trouble to show that the problem, as I understand it, is quite different from this problem which he counts the true one. The two problems have hardly anything in common, and it is well that everyone should see that mine is not his. For his problem is, I feel sure, an illusory one and vanishes as soon as one sees the true relation which vision, as a whole, bears to the retinal image.

It is sometimes said that one never has an experience of his own retinal image. This is perhaps strictly true, and yet it is often misleading, in that it is understood to mean that the retinal image is outside my experience and yet not so alien, but that somehow I can compare its position with that of my visual experience. The fact is, the retinal image is, by representation, made a part of my experience, just as all things which I represent become thereby parts of my experience, even though I do not directly perceive them. And only by thus representing my retinal image and definitely assigning it a position within the world of things actually visible to me does any comparison of its position with that of other objects become possible. It is visualized, or otherwise represented, in definite spatial relation to those parts of the world which I see, and thus becomes an integral part of my larger world of visual and visualized experience, built out beyond and in between the objects of actual sight. My brain, for instance, becomes a part of my visual world because I assign it a definite position within the visual total, though I have never seen it. I represent my brain, not as enveloping my experience nor as having lines of direction independently comparable with those of my visual world, but as itself a part of that total visual world and as having for me no position nor direction except as within that total and as relative to the other parts of the whole. Its position in my world of experience is nothing absolute, but is determined merely relatively to the internal lines of direction and points of reference of that experience. Likewise my retinal image is an integral part of my visual world. Its place is within my visual total, and its position and direction are determined only by making use of the directions of reference within that total. Why it should have the position and direction there which it does have; in other words, why the rest of my visual world and that small portion of it, which I call my retinal image, should have the peculiar spatial relation they do have, is a matter of optics and vertebrate morphology, not a problem for psychology.

The position which, from our knowledge of optics, we assign the visual image within our visual world does not mean that our visual experience bears an inverse relation to something *external* to that visual experience, as Professor Hyslop seems to think. This relation is in no sense a relation between two heterogeneous terms, one of them a system of visual experiences, and the other an alien counterpart inverse to these. Since our only way of comparing the image with our visual perceptions is by representing it relative to their position, and as embedded in their larger system, its relation to the rest is no indication of the relation of the whole system of visual perceptions, or of the visual process as such, to something else. It does not give us the slightest warrant for holding that the visual process includes, for instance, a process of spatial transposition of objects into some other direction or order than that given in the immediate retinal stimulus. The *interrelation of objects*, not the absolute position of objects, is what we wish to know by sight, as by touch. Even if we could make absolute position at all intelligible, a knowledge of it would be of no earthly use to us, except in so far as it might guide us to a knowledge of the relative situation of things. Now our vision gives us this *interrelation of objects* exactly as their images are interrelated in the retinal image. We see things in the very same relation to our body that the images of those things bear to the image of our body on the retina. Later on, the reflective mind wishes to add into its visual system of objects other objects not given in vision, and among the rest interpolates one small item not appearing among the images on the retina, namely, the retinal image itself. The fact, that I represent among my objects a smaller inverted image of some of them, seems to me no better evidence than, for instance, an inverted chair among my visual objects would be that transposition or reversal takes place in the process of vision itself. If Professor Hyslop really thinks that the position of visual objects with reference to the visual image reveals a peculiar character in the visual process itself, such as to constitute a problem, there must be for him a still more serious problem in the fact that our visual objects appear to be in front of our head, though the real organ of vision is in the occipital cortex.

Vision as a whole and by itself is indeed neither inverted nor upright. Objects *within* the visual system may be inverted or upright with respect to other objects in the system; but the whole cannot by itself have either of these characteristics. For this reason there can never be a purely visual problem of upright vision. And since visual experience cannot be compared with things-in-themselves, nor con-

sequently with the retinal image-in-itself, upright vision must mean a vision which gives us objects upright with reference to some non-visual experiences which are taken, for the time being, as the standard of direction. Upright vision, in the final analysis, is vision in harmony with touch and motor experience; and the only problem of upright vision is one concerning the necessary conditions for a reciprocal harmony in our visual and tactual or motor perceptions.

Now the actual conditions of vision make it seem, to a person who takes an uncritical common-sense view of things, a matter of surprise that there is harmony between these different kinds of perceptions. Since the retinal image of any object lies in a direction inverse to the object as a touch experience, the nervous basis of vision seems to be in discord with the system of tactual perceptions; how does it come about, then, that there is mutual harmony in the two forms of perception? The theories which may be roughly styled the projection and the eye-movement theories answer this question by stating, each for a different reason, that vision reverses the retinal direction of objects. The real visual direction, as distinct from the merely retinal direction, is thus, according to these theories, identical with the touch direction, and the problem is solved. But an implied corollary of either of these theories is, that if the retinal image were *not* inverted with respect to the tactual position of things there *would be* discord between the two kinds of perception. For the same mechanism which hitherto had produced a reversal would remain; the reversal ought, therefore, to take place persistently, and visual objects would in that case be spatially the inverse of their tactual counterparts. These theories tend, therefore, to the result that an inverse relation between tactual direction and the direction of the retinal image is one of the necessary conditions for a harmony between touch and sight.

My experiments make it extremely probable that the harmony rests on no such condition whatever; and this probability is still farther strengthened by later and more extended experiments, of which I hope soon to give a detailed report. Both sets of experiments go to show that when the retinal direction of objects becomes identical with their tactual direction the discord in the experience is only temporary. In fact, the experimental results confirm the truth of the view stated near the beginning of this paper, that we have no reason to suppose that there even is a reversal or transposition of directions in the visual process. *A fortiori*, we need no theory to explain the reversal.

Professor Hyslop, however, points with assurance to certain passages in the report of my preliminary experiment, as proof that such

a reversal was present even under the conditions there described. What I have already said of the relation of visual experience to the retinal image, is, it seems to me, a sufficient answer to his interpretation of the facts. But even from his own point of view the passages he refers to are innocent enough, when one distinguishes carefully between that portion of my experience which was based on the older visual conditions and that portion which was being constructed under the new (experimental) conditions. I stated in my paper that when I artificially turned the retinal image upright I saw things at first upside down. Now, since the retinal image was turned 180° and visual objects, in consequence, were turned 180° , this means to Professor Hyslop that the normal inverse relation between image and objects still held, and that my experiment is only an additional evidence of how persistent this relation is. I admit that in my mixed experience at the beginning of the experiment, and in general throughout the experiment (for the experience to the end was a conflict between old and new), this relation existed. But it existed simply because the experience was a mixture of old and new perceptions, and the directions of reference were largely still the old ones. My 'real' body was, in general, localized as I had seen it in my pre-experimental vision. The retinal image was localized with reference to this older visual position of my body, and not in the way which a complete submission to the new visual experience would have required. As long as my body was localized according to the old experience, and other things in sight were localized according to the new, the two standards for localizing my retinal image were in conflict; so that the image's correct relation to one of these standards meant its inharmonious relation to the other. An entirely harmonious organization of the new experience, based on a full knowledge of the laws of light, would have required that the retinal image should be localized among the objects of my experience, in an upright position with respect both to my body and to the objects represented in the image. But since my body was, in general, still localized by recalling pre-experimental perceptions of it, a localization of the image in proper relation to this old position of the body made the image inverted with respect to the things I saw. And if, on the other hand, I localized the image in proper optical relation to the things it imaged, the relation between the image and my body was incorrect. In general, I no doubt remained faithful to my body and let the outer contradiction take care of itself.

But all this is only a transitional state of consciousness. Suppose

that the partial reharmonization of my experience had given place to a complete harmony of tactual and visual perceptions and to a suppression of my old localizations brought over from the earlier experience—a result toward which the experiments surely point;—I would then feel and see my body unreservedly in its new place in the visual field, and in the same relation to the new objects around my body, as existed between my body and surrounding objects in the older experience, viz., my feet on the ground, my head toward the sky, etc. The proper localization of my retinal image according to the laws of experience, would now produce no such contradiction as was inevitable during the earlier, transition state. I could localize the image—and a self-consistent organization of my new experience would force me to localize it—upright with respect both to my body and to the objects pictured in my image. The inverse relation between my retinal image and the objects perceived would here have disappeared.

The result toward which the experiment points has thus a most definite bearing on the problem of upright vision, even in Professor Hyslop's sense of the term. And instead of adding testimony to the persistence of the inverse relation between image and objects, it really shows that this inverse relation is a psychologically non-significant accompaniment of the peculiar lens-arrangement of the eye, and would disappear could we but change the eye in that regard alone. If our eye had contained a more complex system of lenses instead of the simple arrangement we actually have, there would have been no hint in our experience, and certainly none outside of our experience, of any mutually inverse relation of objects and their retinal images.

Through the courtesy of the editor, I have been permitted to read advance sheets of Professor Hyslop's article in the present number of this REVIEW. The grounds upon which he denies the pertinence of my experiments to the question I had in view are fully covered, it seems to me, by what I have already said. Nor do I see that he has yet produced a single fact to show that the interrelation of visual objects is not *identical* with the interrelation of their retinal stimuli. Since visual objects have no absolute position or direction, but only relative position and direction, there is no evidence that vision reverses or transposes anything, until some one shows that vision gives us objects in some different order or interrelation from that which their images or stimuli have *among themselves* on the retina. Only a reversal of this sort would give us a visual problem. And since no such reversal or transposition occurs, there is no exclusively visual problem of upright vision, as Professor Hyslop supposes.