

THE ALCHEMY OF LIGHT AND COLOR

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VISION AND REALITY

IMAGINATIVE scientists have sometimes amused their readers by surmising how the world would appear to human beings if they had a different set of sense organs, or if their receptors were tuned to respond to frequencies to which they are now insensitive. Since, in man, the eye, the organ of vision, is the most important receiving apparatus of the body, these speculations frequently take the form of theorizing about how the world would look if our eyes were differently constructed.

That the world would appear quite different is easily shown. Bertrand Russell begins his book on the *A B C of Atoms* with these lines: "To the eye or to the touch, ordinary matter appears to be continuous; our dinner-table, or the chairs on

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which we sit, seem to present an unbroken surface. We think that if there were too many holes the chairs would not be safe to sit on. However, science compels us to accept a quite different conception of what we are pleased to call 'solid' matter; it is, in fact, something like the Irishman's definition of a net, 'a number of holes tied together with pieces of string.' Only it would be necessary to imagine the strings cut away until only the knots were left." Mr. Russell, unfortunately, does not tell us why, if matter is so porous, chairs *are* safe to sit upon. I venture the statement that this is so because what we use in sitting on the chair is made of the same sort of stuff, or rather the stuff is approximately of the same order of density and texture, as the substance which is sat upon. An electron, especially if in rapid motion, would probably find the seat of a chair quite permeable. If human beings were made of stuff as heavy as that of the astonishingly dense satellite of the star Sirius they would probably experience great difficulty in keeping from falling through, not only chairs, but most everything else on earth.

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Furthermore, our eyes are also made of approximately the same sort of stuff as the things we see through our eyes. But if we were equipped with eyes capable of ultra-microscopic vision, we might see through many things which now seem quite solid. With such eyes the smooth tops of tables would resolve themselves into mountains and valleys. If, like Alice in Wonderland, we could control our size by eating mushrooms, we might reduce our size to the point where we would stub our toes on atoms, or fall in love with electrons! Perhaps we could also see the sunlight in cucumbers, which, according to Swift, philosophers of a certain country were trying to extract. (It is really there, botanists now tell us.) On the other hand, if we were giants larger than the one whom Voltaire imported from Sirius we could regard the Milky Way as a small but rather hot grain of sand.

Such excursions into the two infinities of the universe, the infinitely little and the infinitely big, are quite outside the range of actual experiment. Another line of speculation is open to us, based on the probable experiences of actual organisms.

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Thus it seems natural to suppose that insects see better over small areas; in any case they probably don't see very much on a macroscopic order. We, on the contrary, have a much wider purview of surrounding space, but we don't see as clearly as we would if we had lenses with the magnifying power of microscopes. Perhaps the price we pay for seeing so much is that we see so little of the little things. Moreover, as we are told by Dr. Ladd-Franklin, the eye has undergone an evolution, which means that the more recent types of visual experience which occur in us cannot occur in the lower organisms. Undoubtedly these animals, lacking some or all our color sensations, must see the world in quite unique ways.

Now if vision has evolved in the past, why should it not continue to evolve in the future? Just as there are living creatures capable of hearing what we may call super-audible sounds, so there probably are creatures capable of seeing what for us is super-visible light. If the human eye should some day be granted the ability to see in the ultra-violet region of the spectrum interesting consequences would fol-

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low. All substances which emit the ultra-violet light which is now invisible would then appear to be surrounded by an aura or halo. Thus, mercury, which I have been told gives off an invisible emanation, would then be surrounded by a glowing vapor. Perhaps we would also see human bodies enveloped by some sort of penumbra, as those persons allege who claim the gift of "clairvoyance."

Such speculations may seem to possess little practical value, but they become of great theoretical interest to the philosopher. They serve to loosen up our all too ossified habits of thought. They also lend plausibility to the reality of the problem which the metaphysicians call the "problem of reality." What is the real world? Such speculations as we have just indulged in make it clear that the world as it *appears* to us is largely the product of our sensory equipment. That the external world *is* our set of reactions is indicated by the experiments of Stratton, who wore spectacles reversing the ordinary spatial orientation of the external world, and found that he could get along just as well after the first readjustments. Poincaré

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has also suggested that the world we live in is a property of the distribution-board in the brain. This idea that our habits of thought are built around our sense experiences follows from the fact that the eye is a projection of the brain itself. The way in which this perceptual world prejudices our world of concepts is pointed out by Bergson.

If one were so minded (as I now am), one could concoct still more bizarre ideas by the following line of thought. We recognize certain types of experience as being unusual. We call such experiences "hallucinations" and "delusions." Instead of giving us the truth about reality, we suppose that they are the products of a "disordered" mind. When we incarcerate the "insane" persons in institutions we apply the test of accepted social standards. A sane or normal person is one who conforms to the standards set by the average man. The norm is established by what the majority sees and believes. But let us suppose, for reasons which Mr. H. G. Wells might give, that the insane people increase in number to the point where they outnumber the sane. It is conceivable

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that in time we would not be able to control them. What would then happen? Perhaps they might put the so-called sane people into institutions, and they themselves, being now in the majority, would then run the government. The first measure they would probably enact would involve a substitution of their test for the test of sanity formerly in vogue. Now if the test of sanity is a social test these maniacs whom we formerly held to be victims of hallucinations and delusions would then possess veridical experiences. (The relativity of insanity must follow from any view in which insanity is regarded as a set of responses rather than as a *thing* in man, produced, perhaps, by obsession.) Something like this happens in the cases of "insane" persons who are simply geniuses in advance of their times. The way in which the abnormal may become normal is seen in the fact that unless we are subject to certain common illusions, we are really abnormal.

But hold on! someone objects,—a set of maniacs could not run the government; they are incapable of social cooperation and legislation. In reply may I point out

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that perhaps we exaggerate the extent of the coöperation of sane people. I wonder whether a set of lunatics could have made a much worse job of international coöperation than we sane people—who came so near to exterminating “civilization” a decade ago? The subtlety of the problem can be indicated by the following conversation between a mathematician and a professor of abnormal psychology: The one said to the other, “You psychologists are always studying illusions—you live your whole lives in a world of false ideas.” The reply of the psychologist was this, “Did it ever occur to you that what you call truth is only a delusion so deeply rooted that you haven’t been able to bring it up to the light?”

At this point in the argument someone is likely to demur, and point out that the test of reality is not solely a social test, but others are also applied. True, it will be granted, when a man sees pink elephants or snakes in his bed of the existence of which he is sceptical, he appeals to his friends, and if they see them also his faith in the validity of his own perceptions is remarkably strengthened. But collective

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hallucinations may sometimes occur. Group hypnosis can be produced. (Descartes considered the idea that a malicious demon might be misleading the whole human race into believing that there was an external world.) Certain religious skeptics have even supposed that the alleged miracles of the New Testament, such as the Resurrection, were due to group hallucination, produced by suggestion and self-hypnosis. Since this is possible we must bring in the other tests. If we see something, the existence of which we doubt, we also try to feel it. Thus one sense is used to supplement and check up the other. But in reply may I point out that this does not give us absolute certainty. Why should we put more faith in touch than in vision? We sometimes see things which we cannot touch. The mirror image of a pin is a case in point. To explain away the image by appealing to the principles of geometrical optics does not finally dispose of the matter. There are too many tactual illusions, and too many unfelt realities to rest the whole case on touch. It has been pointed out that sight is simply "anticipative touch,"

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and that both give us only relative truth.

The upshot of this whole matter is that we must conclude that what the world is, aside from the way in which we perceive it (or the way in which it *appears* to us) we do not know. Only a god (or a philosopher) can tell us what ultimate reality is. We have heard much these last few years concerning the psychology of philosophy—what we now need is a philosophy of psychology!

Instead of attempting the heroic task of pursuing the Absolute on a grand scale, let us restrict ourselves to the problem hinted at in discussing the evolution of vision. We saw that what we perceive is a function of our sensory equipment. Now how did the senses come to be what they are? By passive adaptation to an eternally fixed environment of external nature? But isn't it also true that the environment was created by those sense organs as they came into existence? Doesn't the eye create the light it sees as truly as the light builds up the retina which responds to it? If so, which preceded which? (Frequently the glib use of the terms "organism" and "environment" sloughs over

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certain very baffling problems.) Rather than try to answer such profound questions in general terms, let us turn to a specialized phase of the problem, the problem of color vision. Here is an excellent opportunity to come to close grips with this problem of the relation of the subjective and the objective.