

Some Considerations upon Perception¹

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I propose to discuss in general terms some recent neurological and neuro-physiological views upon perception—which seem threatened with obscurity by the introduction of epistemological factors into what purport to be physiological accounts of this complex process. One or two writers have chosen, unfortunately, I submit, to resuscitate Locke's famous doctrine of primary and secondary qualities in perception, which doctrine we owe in the first instance to Galileo.

By the term 'perception,' I refer to sensory perception in all its modes, not limiting myself to visual perception, since some confusion has arisen in the past by such restriction.

Before I proceed, I should define my operative term, 'perception.' Except in the case of infants, lights and colours and sounds do not enter consciousness without some significance and without some measure of interpretation. For example, auditory reception pure and simple is rare. Sounds come into the focus of attention as spatialized, and identified as to their source and significance. This perception has physiological and psychological elements and affective accompaniments, and is in effect a product of experience, as Rheinhold has recently reminded us. The same holds true for other sensory modalities. Simple sense reception is what Whitehead calls 'sense awareness.' When this is enriched by these accompaniments, when in fact it involves thought and feeling, it is better spoken of as 'sense perception.' Simple sense awareness or reception is the fleeting endowment of the infant, rarely to be repeated in later life, save in circumstances unprecedented for the individual.

I THE PROPER LIMITS OF PHYSIOLOGY

The problem of perception has interested philosophers, psychologists, and physiologists, as well as the anatomists of the nervous system, and

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there are therefore several valid fields of discourse about it, which should not be confused.

When approaching it as a neurologist—that is, in the role of clinical observer or experimental physiologist—I must first confine myself to the dynamic properties of the nervous system insofar as these are involved in processes that, in some fashion, issue in perception. There is nothing else I can discuss without trespassing in the territories of philosopher or psychologist. These latter two are in a like position, in that each has his proper method of approach.

Yet, the modern literature dealing with perception seems to show that all three are inveterate trespassers, at one moment discussing nature as perceived, at another the action of nature on the mind, and at yet another the anatomico-physiological basis of perception, as though but a single discipline of thought were in question. In this, we whose first interest is the activity of the nervous system are perhaps the worst offenders.

A few physiologists have tended of late to infuse their accounts of perception with an epistemological element, which they have not properly distinguished from what is physiological. The philosopher can hardly formulate a theory of perception in an anatomical and physiological vacuum; and epistemology is not within the field of the physiologist since, as a natural scientist, he is concerned with nature as perceived and not with what nature does to the mind—that is, with the theory of knowledge, or epistemology.

I think that the tendency to confuse the limits of the two disciplines of thought, philosophy and physiology, is revealed in an address entitled 'On the Neurological Approach to Perception' by Russell Brain. He says, 'Epistemology seems to me to be the cardinal problem in modern thought, for we cannot separate our conclusions concerning the nature of perceiving from our conclusions as to the nature of what we perceive.' This statement seems to me to confuse the two distinct problems of 'nature as perceived' and 'what nature does to the mind.'

Again, of whose modern thought is epistemology the cardinal problem? Surely of the philosopher's alone. The natural scientist, whether he be chemist, botanist, geologist, or physiologist, is concerned with nature as revealed to him in experience and need never give a thought to the nature of perceiving—and, indeed, he rarely does. In sense perception, nature is disclosed as a complex of entities whose mutual relations can be thought of and expressed without reference to sense awareness or thought about it. What epistemological issues do we find

raised by Sherrington, for instance, in the great corpus of original contributions to the physiology of the nervous system that we owe to him?

Similarly, the remarkable development of mathematics and physical science—as opposed to biological—in the seventeenth and eighteenth centuries can hardly be said to have been catalyzed by Locke's doctrine, or hindered by Hume's and Berkeley's refutations of it.

It seems to me, therefore, that this so-called neurological approach is not neurological, but epistemological, and thus not within the field of discourse of the neurologist *qua* neurologist.

II LOCKE'S DOCTRINE EXHUMED

Since I suspect that some current confusion of thinking is partly attributable to a revived and belated interest by physiologists and clinical neurologists in Locke's doctrine of primary and secondary qualities, together with the basis of Newtonian physics upon which it rests, I propose—with the diffidence proper to one who is not a philosopher but is nevertheless reluctant to let himself be hypnotized by the genius of one—to cast a critical eye on John Locke, by way of preliminary.

I appreciate that I might be flogging a dead horse were I to address an audience of philosophers on this subject, but the reasons that make it dead for me as a neurologist may not be quite the same as those that led Bishop Berkeley and Hume to give it its quietus.

I have said that the proper study of the natural scientist is nature as revealed in perception. Whitehead tells us, in a definition to which he makes important qualifications, that 'nature may be defined as the world, as interpreted by reliance upon clear and distinct sensory experiences: visual, auditory, and tactile.' To these, the physiologists today would add the sensory experiences that we derive from the proprioceptors in muscles and labyrinths. Let me start from this definition, leaving for later consideration Whitehead's reservations to it.

As a physiologist or neurologist, I have to consider Locke's doctrine in the light of modern physiological knowledge and to avoid the error of the reverse—that is of trying to accommodate this knowledge to the postulates of Locke's doctrine. In expounding it, Locke says, 'It shall suffice for my purpose, to consider the discerning faculties of a man, as they are employed about the objects they have to do with'—he disavows any intention of dealing with the physical basis of perception. Yet, in fact, it was the latter that he did when he offered a physical

theory of perception based upon Newton's views of the particulate transmission of light and sound.

III NEWTONIAN BASIS OF LOCKE'S DOCTRINE

According to Locke's doctrine, bodies—or matter, as we may say in Newtonian language—as revealed to us in perception have primary and secondary qualities. The primary qualities are figure (or extension), solidity, and motion. The secondary qualities are colour, sound, scent, cold, and heat. The primary qualities are postulated as utterly inseparable from matter: they are its true attributes, however minutely it be divided. The secondary qualities, on the other hand, arise by what he calls 'a power' of the primary qualities to produce these sensations in us. The secondary qualities are not in nature and resemble nothing that is in it. They have, by this theory, no other reality than as mysterious agents of neural excitation.

It appears, then, that the secondary qualities are derived from the primary. This curious relationship becomes difficult to grasp when Locke tells us that both qualities derive from two separate physical processes of a single type. Thus, he says, since we perceive bodies at a distance, 'some singly imperceptible bodies,' as he calls them, must come from matter to the eyes and thereby convey to the brain 'some motion which produces in us those ideas of it which we have.' Similarly, the secondary qualities are also conveyed to us by what he calls 'insensible particles of matter, of peculiar figures and bulks, and in different degrees and modifications of their motions.' To-day, of course, if we stated this doctrine we should use the term 'waves' for 'particles', at least in relation to light and sound.

I venture to submit that this of itself is not a coherent proposition, and in addition it abolishes from nature everything but the so-called primary qualities of matter. I ask myself whether I am to regard it as a proposition in philosophy or rather as an attempt to give a physiological account of sensory perception based upon the physics of Locke's day.

The more closely we look, the more indistinct becomes the postulated difference between primary and secondary qualities. Thus, Locke says of one of his primary qualities, 'If anyone asks me what this solidity is, I send him to his senses to inform him'; that is, to those very senses which have already bred in him the illusion that the red which he sees is in the rose before him and not in himself alone.

Again, taking vision singly, the confusion seems to deepen, for Locke says that 'vision conveys to our minds ideas of light and colours . . . and also the very different ideas of space, figure and motion . . . we bring ourselves by use to judge of the one by the other.'

Thus, we may judge of space, solidity, etc., by sensations of colour. Surely, the distinction between primary and secondary qualities breaks down if this be so:

Hume, the apostle of scepticism, who followed close and critically upon Locke's heels, was more realist when he said in his *Treatise of Human Nature* that 'my senses convey to me only the impression of coloured points disposed in a certain manner. If the eye be sensible of anything further, I desire it may be pointed out to me.' Hume also concluded that the grounds for regarding sensations of light and sound as secondary and unrelated to nature were equally applicable to sensations of form, solidity, etc.

A further difficulty was noted by William Hamilton, the Edinburgh metaphysician of the early part of the nineteenth century. He could not adapt sensations of hardness, softness, roughness, and fluidity to either of Locke's categories and referred them to a third category of 'secundo-primary' qualities, the status of which I find incomprehensible.

In short, we are invited to believe that we enjoy two qualitatively distinct orders of sensory experiences with these mutually incompatible qualities: that the one is derived from the other, yet both arise independently by two sets of particulate transmission; that each gives a fundamentally different revelation of nature, but the secondary set, which resembles nothing that is in nature, can yet reveal to us—and, upon occasions, be the only means of revealing to us—those primary qualities that are the true attributes of nature.

This seems to be an incoherent hypothesis, an abstraction from the realities of nature, given to us by neither physiological nor psychological avenues of knowledge, but ruthlessly formulated to provide a notion in accord with Newtonian physics.

I wonder whether any modern neurologist or physiologist who now calls Locke's doctrine in aid in the formulation of a theory of perception has ever read his essay on human understanding, in which this doctrine is expounded. I think it unlikely, for it is so much more complex than the inadequate summaries they give.

Locke's doctrine, then, was an epistemological one conceived in a biological vacuum. Yet, perhaps, we should not blame him for this vacuum. After all, comparable endeavours by physiologists, who should

know better, to create physiological doctrines out of their heads were being made throughout most of the eighteenth and nineteenth centuries, and the enterprise still finds its devotees in our own enlightened days.

Yet, whatever excuse there may have been for John Locke, there can be no excuse in the twentieth century for accepting his notions of perception as in any way related to modern physiological knowledge.

IV PRESENT-DAY EFFECTS OF LOCKE'S ERROR

My justification for this lengthy critique must be that, except in some of the writings of Whitehead, which the majority of natural scientists can hardly be persuaded to read, I have found no modern analysis of Locke's doctrine that shows any physiological insight into its implications. It is remarkable that a man trained as a mathematician (as was Whitehead) should have had so keen an eye for nature and for detecting the limitations of those bleak abstractions which are detached fragments of it that take no account of all that is left in the discard.

Summing up the achievements of the seventeenth century, which Whitehead calls the century of genius, and paying his tribute to it, he concludes that its conception of the universe was unbelievable and framed in terms of high abstractions; the paradox arises because the abstractions have been mistaken for concrete realities. A comparable verdict is given by Collingwood in his book *The Idea of Nature*.

In spite of this, the doctrine still infects the physiologist's thinking about perception, and both Eccles and Russell Brain endeavour to express it in their own terms as relevant for the physiologist. For example, in the address of Russell Brain from which I have already quoted, we read: 'Broadly speaking, primary qualities correspond to those relations between sense data which are spatially discriminated by means of the cerebral cortex as an area extended in space, and secondary qualities are those sense data which are prehended through the capacity of nervous tissue to create a new kind of four-dimensional unity out of successive-ness.' It is for the philosopher to make what he can of this statement, which has yielded up no meaning to me.

Eccles, undertaking the same mission in his Wayneffete lectures 'on the neurophysiological basis of mind'—i.e., to adapt physiology to this epistemological doctrine—does so differently. He says: 'We can regard the perceptual world of each observer as a kind of map built upon the

spatial relations between objects in the external world, but also giving symbolic information in terms of the secondary qualities, as is customary in ordinary maps with their conventions for rivers, towns, railways, etc. Colours, smells, heat and cold as such, belong only to the perceptual world of an observer and are merely symbolic of events in the physical world, which they are quite unlike.'

Here, surely, is confusion worse confounded. Also, the analogy seems false. In Locke's doctrine, colours are not presented as symbolic of anything in nature. They are merely mysterious modes of neural excitation, of the purpose of which he can give no account. On the other hand, the colours in Eccles' maps are man-made, conventional symbols in a graphic mode of human communication. What, in fact, he is asserting is that we see the relations of symbols which cannot be related to anything in the external world. Surely a meaningless conclusion, for a symbol without a *relatum* is not a symbol.

Both writers restrict their attention to visual perception—that is, to half the seamless coat of sensory perception.

In some current neurological accounts of visual perception modelled on Locke's doctrine, the object in nature postulated as being perceived is usually a table. When we direct our gaze at this, events of two orders are said to occur. (a) There is an unexplained, and so far inexplicable, excitation in the visual cortex of the brain, which enters awareness as a colour or colours. This is a private affair, wholly uninformative about anything that may be going on in what is called 'real space.' (b) By virtue of a concomitant excitation of the visual cortex—perhaps the same or a separate excitation, we are not told which—a shape enters our awareness. This is taken to indicate the presence of an object in the external world: that is, the percept is related to nature and reveals some attributes of it. While colour lives only in our perceptual space, the coloured shape leads a double life: in our private perceptual world and, as an attribute of matter, in real space also. In terms of pure description, without these quasi-metaphysical trimmings, we have a coloured region, and if we were to abstract the colour from the region, we cannot conceive what would be left in our field of vision. The shape would follow the colour into invisibility, as the grin of Lewis Carroll's cat followed it into the void.

The metaphor starts an amusing, if irrelevant, reflection, one that may have occurred to others before me, namely, that Carroll's two *Alice* books, so often thought of as written for children only, are the most profound metaphysical works that Oxford has given to the world

since the Franciscan friar Duns Scotus held a professorial chair in that university in the thirteenth century. They bristle with scarcely concealed philosophical implications.

I submit that, from these blends of physiology and epistemology, both disciplines emerge the worse for wear. So much for Locke, and for attempts to reconcile his doctrine with modern physiology.

V 'EVERYTHING PERCEIVED IS IN NATURE'

I come now to my proper task of giving some brief statement of the physiological basis of perception, and also of asking whether this provides any evidence of the dichotomy in perception that Locke proposed. Is nature still to be thought of as not more than the colourless, soundless, scentless hurrying to and fro of bits of matter in absolute space that Galileo and Locke believed it to be—a world of quantity without qualities?

To anticipate my conclusions, I submit summarily that in respect of the information they deliver about nature, all our sensory modes give a like order of revelation, and by a single order of physiological process. I accept Whitehead's aphorism (in *The Concept of Nature*) that for natural science 'everything perceived is in nature. We may not pick and choose. For us the red glow of the sunset should be as much a part of nature as are the molecules and electric waves by which men of science would explain the phenomena . . . So far as reality is concerned, all our sense perceptions are in the same boat, and must be treated on the same principle. The constructions of science are merely expositions of things perceived.'

At the moment, our ideas concerning the anatomical substrata of somatic sensation are in the melting pot. That the four modalities of cutaneous sensibility—touch, pain, heat, and cold—have each a specific type of end-organ, or receptor, attuned to one, or to a selection, of the possible modes of cutaneous stimulation is the notion under question. In the form in which it was presented by Head and Rivers, it was manifestly untenable. They held that protopathic temperature sensations were subserved by punctate 'heat' and 'cold' spots but epicritic temperature sensations by some hypothetical non-punctate system of end-organs of which nothing is known; while both epicritic and protopathic touch were subserved by the same punctate 'touch' spots. I cannot here go into all the details of this curious arrangement, which I have discussed elsewhere.

But it has hitherto been generally held that the skin and subcutaneous

tissues contain certain morphologically distinct forms of sensory end-organ, each of which could be correlated with some specific sensory modality. Of late, however, Weddell and his co-workers have claimed that large areas of skin contain little but naked sensory nerve endings of a single form, and yet these areas possess all the described modes of sensibility. Weddell suggests that the different modalities of cutaneous sensibility may depend upon the pattern, duration, and intensity of stimuli, and that whether we experience pain or touch is determined by what happens at the nonspecific receptor end of the sensory pathway.

If this should prove to be the case, then a more dynamic point of view might replace some of our old ideas of the morphological foundations of somatic sensory function of the nervous periphery, just as has been the case with respect to the brain. There are the examples of the cortical mosaic of the precentral region, the parcelling of the cortex into the two hundred 'organs' of Vogt's scheme, and now the present wide range of morphologically distinguishable sensory end-organs in the skin. We might hope to see a neurophysiology which, while not forgetting that function demands its structural facilities—and no less that these shall be determined by us—will nevertheless not seek to imprison function within the framework of topographies that have uncertain or no biological meanings.

Our morphological knowledge of the central sensory paths is far from complete also, as a beautiful recent paper of Dr George Bishop of St Louis indicates, but it seems clear that all modes of sense awareness depend for their evocation upon the cortical or other destination of the different components of the sensory pathways.

By speaking of sensory functions, I am making that passage from the physiological to the mental that I have mentioned. Hughlings Jackson, writing as a physiologist, was acutely aware of the difficulty and sought to avoid it by speaking of 'impressions' and by defining the nervous system as 'an organ for the co-ordination of impressions and movements.' For him, the word 'sensation' to describe neural activities was as illegitimate as was the word 'voluntary' to describe movement.

I do not presume to know how nerve impulses become, or give rise to, sensations, nor do I understand how the two can be reducible to one. All I assert is that our various sensory modalities—visual, auditory, olfactory, and somatic—depend upon the integrity of various afferent pathways from the organs of special sense and from the body surface and depths; that these pathways reach the brain functionally grouped; and that we may therefore, without prejudice, speak of visual, auditory,

and other sensory regions. It remains to be discovered how these constant streams of afferent impulses are so co-ordinated and transformed that nature is ultimately revealed to us as we know it.

Even to summarize the 'double talk' in many physiological papers which attempts to account for perception, learning, memory, and thought in biophysical and cybernetic analogies—this would take a lecture all to itself.

Thus, when all is said in these physiological endeavours to account for mental phenomena, we have not bridged the gap between nerve impulses, on the one hand, and sensations and discursive knowledge, on the other. However intricately woven in time and in cerebral space may be the patterns of nerve impulses, they do not reveal the 'how' of sense awareness or of knowledge. I know of no other conclusion that is possible within the language of physiology, or its field of discourse. The psychologist and the physiologist must co-operate across the gap, but they may not hope to bridge it by a common language.

In short, underlying every sensory modality, external stimuli impart some mode of motion to sensory receptors of all types: distance receptors, exteroceptors, proprioceptors, and interoceptors, to use Sherrington's grouping. This transmission sets up motion, or exchange of energy in nerve fibres: that is, it evokes nerve impulses, and these, reaching their cerebral destinations, and being patterned and selected in ways we know little of, become known to us as modes of sensory awareness or perception. In each instance there is some mode of physical transmission to the nervous system: light waves of varying lengths, sound waves, heat added to or extracted from the skin, contacts and pressures that transmit movement to receptors. Muscular contractions and relaxations do the like to proprioceptors.

What is there in this singularly uniform physiological process to suggest, or to provide evidence of, the delivery to us in perception of two qualitatively different revelations of nature? Physiologically and psychologically, we cannot detect this mysterious bifurcation of nature, as Whitehead calls it.

Thus, the distinction drawn between the information nature delivers to us by what are now called the distance receptors and that delivered to us by the somatic sensory receptors appears an arbitrary one, having no physiological sanction. The distinction was forced upon Locke by the intellectual necessity of conforming to Newton's physics, which envisaged nature in its ultimate factors as matter located in absolute space.

I submit, therefore, with Whitehead, that we may no longer passive-

ly cling to the notion that we have two sets of sensory experiences, one belonging to objects in an external world, the other being a meaningless product of our mental excitements. All our sensations must sink or swim together. Neither group reveals the ultimate factors in nature as physicists now propose them to us. When colour is perceived, the relevant nerves are excited and transmit their message, as nerve impulses, to the brain. When by touch, pressure, and handling we note what we call form, size, solidity, hardness, softness, or texture, other sensory nerves are excited and transmit their physically identical messages to the brain. The one set does not convey colour, nor the other shape, hardness, or softness. If the optic nerves be severed, we perceive no colours; if the afferent limb nerves are severed, we perceive neither form, nor size, nor texture. Yet when these nerves are intact, we perceive all these sensory modes.

Surely sensations of solidity and form are as remote in character from the ultimate factors in nature as now given to us by physicists as are colours, sounds, and scents. Even the reading of scientific instruments of precision, upon which our ultimate ideas of nature depend—the dials, the scales, the meters and moving beams of light of the mirror galvanometer, the revelations of the electron microscope, and so on—comes down in the end to our perceptions of regions variously coloured, and to the drawing of inferences from our visual perceptions, which appear to generalize and to flow from the perceptions.

For the natural scientist there is but one nature, and that is nature as revealed in experience. It is his task to correlate the appearance of nature with those characteristics of it that are not obvious at first sight—characteristics that the speculative physics of our time show to be profoundly different from the simple notions of them accepted in Newton's day. All sense perception is superficial in its discernment of nature, and our accounts of nature are as superficial and incomplete.

It would be ironical indeed if we were to find, two and a half centuries after Locke formulated his doctrine of primary and secondary qualities, that it is the so-called secondary qualities that really remain supreme as our guides to nature, while the primary qualities as he postulated them merely recall an abandoned and inadequate concept of nature, yet one still lingering in the minds of some neurologists, cherished like the tresses of their dear departed that were worn in lockets on the undaunted bosoms of our great-grandmothers.

I should have liked to discuss briefly Whitehead's important reservations about the adequacy and primacy of 'clear and distinct' sensory

perceptions in the interpretation of nature. He speaks of the dim foundations of bodily experience, to which discrimination of detail is secondary, and he insists upon how superficially all sensory modes reveal the fundamental activities within nature. Sense perception *as we commonly describe it* is an abstraction from the totality of experience. But all this may be read in his book *The Concept of Nature* and particularly in some fascinating lectures in the volume entitled *Modes of Thought*. No student of perception should miss the sixth, seventh and eighth lectures in this book.

If the neurologist, clinical or experimental, must try his wings in the airy realms of epistemology, it is essential, I believe, that he should go to the only modern philosopher who has shown himself to possess an acute feeling for nature, and who does not dwell exclusively in a dictionary world of bleak abstractions but returns for refreshment from time to time to the study of the concrete. Unfortunately, he is not always easy to read and he is not in the mode. Yet I have no doubt that he has far more to offer the biologist than the arid logomachies of some modern schools, whose colours some of my contemporaries in medicine so love to wear.

VI BABEL

The student of the nervous system faces one of the most complex subjects in biology. If he be a clinician, he cannot leave the matter at the physiological level; he must enter the field of psychology, but always remembering that it has a language of its own and its own field of discourse and that these must not be regarded as identical with those of physiology.

If he makes forays into philosophy, still more must he bear in mind that he is in yet another field of discourse, at a higher level of abstraction, with its own language. He may not indulge in the too common hybrid statements in which anatomical, physiological, psychological, and epistemological terms all jostle together in a sort of happy, but unnatural, intellectual promiscuity.

The physiologists of the early and mid-nineteenth century regarded the medulla oblongata as the seat of consciousness and the *sensorium commune*, a place where all sensory nerve impulses met, mingled, and issued in a unity of perception, in which every element gave not the same revelation of nature, but a revelation of a like order. No one supposed

that we had two wholly disparate modes of perception. Even as late as 1900 in Schafer's great two-volume textbook of physiology which summed up knowledge to its date, and in which the chapter on sensation is written by Sherrington, Locke's name and theory are not mentioned, and we get a genuine physiological account of the substrata of sensory function with an account also of its psychological accompaniments. There is no trace of any attempt to discuss the nature of perceiving in terms of epistemology.

It seems to be only lately that Locke has crept back into neurological literature, breaking up the idea of a unity of perception into two abstractions unrelated to reality. Perhaps we may take the appearance of this strange new fashion as a further indication of the difficulties inherent in the entry of physiologists and physicians into philosophy.

It heartens me, however, to recall that two of the most profound thinkers about the activity of the nervous system of my time, Hughlings Jackson and Charles Sherrington, never ventured out on these unfamiliar paths, or indulged in what seems to me naïve thinking about the nervous system. They talked anatomy, physiology, and some psychology, always distinguishing in which of these fields of discourse they were at any time, and speaking, as it were, in the language of the country.

They were natural scientists who cherished no grandiose illusions that natural science would ever (to use a current financial term) 'take over' the entire realm of human thought, or grasp all the values that inspire it—either by scientists becoming philosophers themselves, or by the easier alternative of talking philosophy away. Philosophy has buried most of its critics and undertakers, and will doubtless bury more. But this does not stop some scientists from making their 'take-over bids.' Such a bid I seem to see in Professor J. Z. Young's suggestion in his Reith Lectures that we may ultimately obtain our most satisfactory account of man in an elaborate statistical and mathematical terminology. This bright idea has all the cheerful irresponsibility of a death sentence upon philosophy and biology, not to mention theology. Happily it can never be carried out.

VII FINIS

One last word: I would not have you think that in this generation we who are clinical neurologists or experimental physiologists are more

prone to error and to confusion of thought than our predecessors of generations past. The nervous system has always been a hard nut to crack, as you will see.

In the year 1631, one Dr Helkiah Crooke, a Fellow of the Royal College of Physicians of London, published a book entitled *Mikrocosmographia . . . A Description of the Body of Man*. Many of the problems raised were dealt with by the method of question and answer. In the chapter devoted to the nervous system, the author poses the following question, which concerns what we now call the decussation of the pyramids: *Why when the right side of the head is wounded or obstructed, the opposite part is resolved or paralytical?*

I will not give you the whole of his answer, but it contains the following passage: 'Some imagine that the nerves in their original are so implicated that the right nerves run along the left side, and the left along the right side, intersecting themselves in manner of a Saint Andrewes Crosse But the levity of this opinion needeth no confutation.'

So you see that we have an old tradition of confident fallibility to live down.

BIBLIOGRAPHY

- G. H. BISHOP. *J. Nerv. & Ment. Dis.*, 128: 89, 1959.
 W. R. BRAIN. *Mind, perception and science*. Oxford: Blackwell Scientific Publications, 1951.
 R. G. COLLINGWOOD. *The idea of nature*. Oxford: Clarendon Press, 1945.
 J. C. ECCLES. *The neurological basis of mind*. Oxford: Clarendon Press, 1953.
 H. HEAD. *Brit. J. Psychol. (Gen. Sec.)*, 14: 126, 1923.
 JOHN LOCKE. *An essay concerning human understanding*. Collated and annotated by A. CAMPBELL FRASER. Oxford: Clarendon Press, 1894.
 M. RHEINHOLD. *Brain*, 73: 203.
 W. R. RUSSELL. *Brain, memory, learning*. Oxford: Clarendon Press, 1959.
 F. M. R. WALSH. *Brain*, 65: 48, 1942.
 G. WEDDELL. *Act. Neurovegetativa*, 7: 135, 1953.
 A. N. WHITEHEAD. *The concept of nature*. Cambridge: At the University Press, 1926.
 ———. *Modes of thought*. Cambridge: At the University Press, 1938.
 J. Z. YOUNG. *Doubt and certainty in science*. Oxford: Clarendon Press, 1951.