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Contributors

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C. S. MYERS

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THE CONCEPTION OF NERVOUS AND MENTAL ENERGY¹ (III).

By C. S. MYERS.

I HAVE only at the last moment been induced to join in this Symposium, because of the unexpected inability of a French and of an American psychologist to contribute to it, and owing to a certain incompleteness in which the treatment of the subject has consequently been left. I cannot hope to do much more than fill in a few gaps and to indicate additional problems for discussion.

In his admirable paper Dr Adrian has directed our attention to the experimental evidence (largely his own) that the activity of medullated nerve fibres manifests itself as a rapid succession of impulses, each of which is followed by a refractory period-a period of recovery-during which a fresh impulse cannot be developed. The corresponding activity of striated muscle fibres manifests itself as a fusion of successive twitches, and after extreme activity these fibres also require a period of recovery; but whether these periods in muscle and nerve are at all analogous is reasonably open to doubt. However, there is evidence (also partly due to Dr Adrian's investigations) that striated muscle fibres and medullated nerve fibres agree in reacting to stimuli according to the 'all or none' principle. That is to say, in any fibre there is no gradation of reaction according to stimulus strength-although individual fibres may differ inter se as to sensitivity to a given stimulus strength. So too, in the heat and cold spots of the skin (according to Dr Head) the reaction is largely ungraded-'all or none,' and time is required for recovery after each such momentary reaction.

In the case of peripheral nerves, all that we know of the nature of their activity is an electric response; and this must be produced by a movement of ions in the active region of the nerve fibre. In the case of striated muscle fibres we also recognize definite physical (including chemical) changes. Dr Adrian holds that because nervous (and muscular) activity thus reveals itself to us as "a special manifestation of physical energy...transferable into other forms of energy in accordance with the laws of thermodynamics," the conception of a special (peripheral) nervous (and muscular) energy is unnecessary. But, as I shall immediately

¹ Read as part of a Symposium at the Oxford Meeting of the 7th International Congress of Psychology, 30 July 1923.

C. S. MYERS

indicate, there is another form of muscular and nervous activity, of the physical nature of which we know almost nothing; moreover, there is the activity of the central and autonomic nervous systems, of the physical nature of which we know even less. What we do know about these activities is that they are capable of affecting muscular activity and hence presumably physical forms of energy. Differing here from Dr Adrian, I maintain that so long as we recognize that living tissue displays activity which can ultimately manifest itself as increase or decrease of physical work, no harm can result from applying the term 'energy,' even though we are ignorant of its nature and are unable directly to measure it in terms of mass and velocity.

What I wish to suggest is that there are two different systems governing nervous and muscular activity—the one concerned in the development of muscular contractions, ungraded and susceptible of 'exhaustion' (to this we have already alluded), the other concerned in the development of muscular posture and tone, graded and susceptible of 'adaptation.' We carry our head erect and our lower jaw raised for many, many hours 'on end,' without manifesting or experiencing fatigue. Our muscles are perpetually kept in a state of (varying) tone *i.e.* tonic contraction—throughout life. So too we can unchangingly endure the continuous light of a northern summer. In this second system, the phenomena of adaptation (and of contrast) replace those of fatigue; sometimes, *e.g.* on prolonged stimulation by warmth, coolness, or colours, where the original sensation disappears with adaptation, the two systems seem somehow to be combined.

For this manifestation muscular posture and tone apparently demand an intact central nervous system and the cooperation of afferent impulses from antagonistic muscles. May it not be that the instances of thermal and visual adaptation, just mentioned, also depend on a similar integration of two sets of antagonistic apparatus—for light and dark, red and green, warm and cool, etc.? If so, are we not forced to conceive of a second kind of activity, totally different from that stressed by Dr Adrian in his contribution to this Symposium? Perhaps it may consist in a certain molecular 'set' of the muscular, peripheral nervous and receptor living substance, by virtue of which the phenomena of prolonged adaptation (and contrast effects) replace those that depend on the consumption of available material manufactured by the cell to provide intermittent flashes of activity. This 'set' seems to involve a temporary static change (or 'attitude') in the living substance, and to be produced and maintained by prolonged, not too intense, stimulation,

150 The Conception of Nervous and Mental Energy (III)

that is to say, by a fairly uniform environment. Whether the ultimate effect of this 'set' be to increase or to decrease expenditure of energy, energy is certainly required in order to maintain the 'set'; and we may, I think, most reasonably assume that what maintains it is the activity of the nerve cell, by virtue of its special, 'higher' connexions and combination with other nerve cells concerned in antagonistic motor functions, thus permitting of reciprocal inhibition and facilitation. Anyhow, energy has to be employed, work has to be done in maintaining tone, posture, inhibition or attitude; and ultimately even here fatigue sets in.

Is it too bold to attempt to recognize these two forms of fatigue in intellectual activity—the one 'explosive,' intermittent, arising from the need to make numerous judgments and decisions, and the other 'adaptative,' continuous, arising from the need to preserve a certain mental 'set' or 'attitude'? This attitude is at first 'spontaneously' maintained by the energy derived from 'interest.' But as the latter tires, conscious voluntary efforts (of the first variety), have to be made to uphold the attentive attitude; the feeling of interest gives place to that of boredom; until finally mental weariness and even mild mental 'disorder' arise.

But it must not be supposed that conscious volitional activity always involves the intermittent 'flow' while unconscious activity involves the continuous 'flow' of energy. All our present knowledge favours the view that, whether (so far as we can ascertain) consciousness is present or absent, no difference need occur in the result. Moreover, as Dr Head has so convincingly shown, certain marks of conscious activity are to be found even at the lowest levels of the central nervous system. Probably in all forms of living matter both forms of activity in varying degree co-exist.

Yet it is difficult not to regard the highest levels of mental activity as predominantly constructive and directive, acting on lower, *relatively* mechanical, systems, much as Clerk Maxwell's hypothetical demons worked in sorting out gaseous molecules or as a train may 'purposefully' make its way now along one set of lines, now along another, now along a third, by external direction. But however much it may differ from blind mechanical activity, such external direction must surely involve work; we seem bound to suppose that, in giving effect to it, energy alike in the psychological and in the physiological aspect and hence ultimately in the physical—is expended. Work must be done in switching the rail points, in setting the neural paths, in modifying the neural 'centres,' now in one, now in another direction—leading to inhibition, dissociation, regression, or their opposites. Whether or not there be a

C. S. MYERS

common fund of '*intellective*' energy (for such it is at the highest levels, although we recognize it, to use Dr Head's significant term, as 'vigilance' at the lowest, 'physiological' levels) which may be employed in the various intellectual abilities with which different minds are differently endowed, is a problem still awaiting solution.

To-day, however, the swing of the pendulum tends to ascribe all mental activity to 'feeling,' and to suppose that all percepts, ideas and volitions, all forms of cognition and conation, derive their motor effects from the energy which they obtain from related affects. According to some, indeed, this energy is ultimately to be derived from a single affect, —the sexual emotion. But the past neglect of instinctive and emotional feelings should not cause us to overlook the activity involved in perceiving or thinking, or to regard percepts or thoughts (e.g. ends) as merely inert 'mental matter' whose 'movement' (nay, whose very 'existence' in consciousness) is dependent *solely* on the force of propulsion or repression derived from feeling. Cognitive and affective experiences are not thus to be isolated in their beginnings. Moreover, as regards volition, self-activity is not identifiable with instinctive and emotional activity: the activity of the 'individual' organism is not the mere sum or resultant of the activity of its abstract parts.

The last point to which I would invite attention is the relation between mental and nervous energy. Energy in general we recognise only by the work of which it is capable; we actually measure it only by the work which it performs; and this work involves a transformation of energy from a higher to a lower level. We know nothing of what, e.g. electrical energy really is: we describe it in lower terms, e.g. of inertia, mass, weight and structure, with which, indeed, according to most recent theory, all energy is endowed. At the same time, however, we do not identify the various forms of energy with each other. Should we, then, because peripheral nervous energy reveals itself as electrical energy, necessarily follow Dr Adrian in identifying peripheral nervous with electrical energy? The latter may surely be a 'degradation' of the former. Still more cogent, to my mind, becomes the acceptance of a special nervous energy when we come to deal with the central nervous system. In our present ignorance I see nothing in such acceptance necessarily incompatible with the doctrine of the conservation of energy.

I feel convinced that the problems of inhibition, control, direction and purpose which we have to face on the psychological side cannot honestly be evaded on the physiological side—in other words, that the outstanding problems of mind and life must ultimately be solved in similar terms.

152 The Conception of Nervous and Mental Energy (III)

I see no reason why we should not throughout identify central nervous energy with mental energy—Dr Head's 'physiological vigilance' with the psychologist's 'mental activity.' I find no difficulty in supposing that this 'psycho-neural' energy, as I would term central nervous energy, assumes a more distinctively mental form as higher, wider and more plastic nervous areas are brought into function.

The only consciousness about which we know anything is selfexperience. It is here that we should expect the highest expression of what I have termed 'psycho-neural energy.' Self-consciousness becomes fundamentally the activity of a hierarchy of the highest nervous elements that are concerned in the most important past and present (? and future) responses of the organism to its environment which inter-relatedly are susceptible of control. Examining the three modes of consciousness we find that the conative disappears when practice and habit no longer necessitate control and direction by that integration of psycho-neural activities which we call 'the self'; that the affective mode also always implies conflict with and inhibition of antagonistic reactions; and that the cognitive mode likewise involves alternative reactions; were the response of the individual to a given stimulus fixed, nothing would b served in his becoming cognitively conscious of it.







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