THE HUMAN BRAIN.*

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Man is distinguished from all other living creatures by the quality and range of his intellect, and on the physical side by the nature of the brain which confers upon him this mental pre-eminence. Moreover, as its exceptional powers were acquired by a process of evolution, the true significance of the human attributes can only be appreciated by examining the history of their development.

The human brain is an instrument so constituted as to impose upon its possessor the vital necessity of cultivating a knowledge of the world and his fellow men. Its distinctive feature is the provision it makes for learning. The very imperfection of the instinctive tendencies it can automatically provoke makes it incumbent on every individual to learn how to live, and to acquire this knowledge from his own personal experience, and by imitating, or learning from his fellow men. Hence the qualities of the human brain distinguish man from all other living creatures by imposing upon him the need to build up rules of life and conduct which are individual and distinctive, and not conformable to any general laws of nature.

The enjoyment of the distinctively human qualities of experience obviously depends largely on special powers of vision, touch and hearing—as well, of course, as taste and smell, with which many other animals are at least as well equipped as we are. The possession of an exceptional aptitude for the cultivation of a high degree of muscular skill, such as we call dexterity, is an essential factor both in the attainment and in the expression of these qualities. But the fundamental element in man's intellectual eminence is the unique character of his powers of vision, the qualities we know by the peculiarly significant words: insight, foresight and the wider vision. The special powers of the human brain confer upon man

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the ability to see the world and what is happening in it with an appreciation of the meaning of visual experience denied to all other living creatures. The comprehension of what he sees, the discrimination of form, colour, texture and of spatial relations, the identification of other individuals, and the ability to read in their gestures and facial expressions something their thoughts and intentions—all these things involve comparison with past experiences of things seen or felt, or of actions accomplished. Apes are probably just as well equipped as we are to see, but they lack the fuller cerebral equipment to interpret the meaning of what they see. They cannot acquire the vast store of complex memories which we have at our command, to compare and interpret the fuller significance of visual experience.

Every human activity involves the principle of continuity, the dependence of our present state of consciousness on our personal experience in the past. The human brain is endowed with the aptitude for making this possible by its almost unlimited powers of recording sensory experience and feelings.

Sight enables us to find our way about, and to know the scenes of our daily life, the hills and dales, the trees and sky, and the various aspects of nature and the kaleidoscopic changes of light and darkness, of brightness and shadow, the colours and shapes of the objects that come within the field of vision, the appreciation of distance and perspective, of size and solidity, of substance and shadow. By vision we learn to recognize our fellows and to distinguish them from one another; to identify their distinctive features, colour and movement; to read in their gestures and the subtle changes in their expressions something of their feelings and intentions, and especially their attitude towards ourselves. The eyes, however, are not merely the instruments whereby we gain all this knowledge; in addition they are the most delicate recorders of our own thoughts and emotions. Almost instinctively we watch the eyes of our fellows. From their direction we can learn something of the objects upon which their gaze and attention are fixed, and the quality of their interest. The most infinitesimal changes in the eyes and eyelids record emotional states which our delicate sense of visual discrimination enables us to detect and interpret, however subtle the changes may be.

Visual discrimination itself could not have attained so high a pitch of efficiency if its development had not been intimately associated with the increase of muscular skill. For the cultivation of skill not only gives the sense of sight a biological usefulness, so

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to speak, to justify and promote its evolution, but such powers of visual discrimination could not have been attained without exceptional precision and co-ordination of the movements of the eyes themselves. As the powers of vision increase they acquire a fuller influence over the animal's posture. The cerebral cortex acquires a direct control over the muscular actions concerned in maintaining the balance of the body, previously automatically controlled by lower parts of the brain, and with this the regulation of the habitual posture becomes a voluntary and consciously regulated action. The attainment of skill depends in large measure upon the cultivation of this voluntary control. By frequent repetition and the elimination of clumsiness and slowness, precise actions and responses attain an automatism which enables the individual to concentrate his attention on the changing circumstances—as the pace and flight of a tennis ball—and use his acquired automatisms of postural regulation and skill in movement to effect his purpose.

Vision conferred on man the upright attitude, and with it a tremendous enhancement of the ability to acquire skill. By doing so not only did its instruments, the eyes, acquire a more advantageous position by being raised higher from the ground, and so acquire a wider range than the crouching attitude of the ape permitted, but the hands were freed to take fuller advantage of their rapidly increasing skill. Man's fleetness of foot and his agility were among the results.

The evolution of vision also was responsible for conferring upon the sense of touch a tremendous increase in delicacy and discrimination. When, under the guidance of sight, the hands became amazingly adaptable and skilful, they became also special organs of tactile discrimination, and this added enormously to the significance of visual experience by helping in the process of acquiring an appreciation of size, form and texture of objects in the outside world. By this co-operation of touch and sight a human being is able to acquire a fuller knowledge of the things he handles. In virtue of these powers he can explore and study his own body. The sense of curiosity was created when the awakening sense of vision first revealed to the startled gaze of man's ancestors the wonders of the world in which they lived. It was the chief factor in stimulating them to handle things, and so incidentally to cultivate both muscular skill in manipulation and tactile discrimination.

The way in which these growing needs were met by the development of the cerebral cortex—the neopallium—as vision gradually became enhanced in importance in man's ancestors is graphically

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displayed. Such progressive enhancement of the influence of vision was only possible in those animals whose limbs had not been subjected to precocious specialization. The fore limbs of the horse, the cat, the bat, and the porpoise, for example, had been variously modified to serve special functions. Fuller cultivation of vision in these animals would have lacked an adequate biological usefulness, as the limbs were too specialized for particular purposes to respond to the new possibilities of skilled use.

But none of these vast powers could be attained until the brain had acquired the ability to record experiences so that visual and tactile impressions could be interpreted by comparison with previous experiences of objects seen and felt. High degrees of muscular skill could be acquired only by prolonged practice and attention to the causes of failure in the past. Man acquired the ability to accumulate knowledge and to interpret the meaning of experience by comparison with memories of previous feelings and sensations. Obviously continuity of experience is an essential quality of human behaviour. Man can interpret his present reaction to the world and to the society in which he lives, and shape his actions to meet the needs of the moment, only if he has the criteria for comparison and the skill acquired by long training to display the appropriate reactions. Thus the distinctively human character necessarily involves the continuity of experience. The historical method of study is therefore essential for the interpretation of human thought and conduct.

The evolution of speech enormously emphasized the significance of man's dependence on his social environment and past history. The comprehension of the meaning of things and actions witnessed prepared the way for the development of speech—which involves the identification of objects in the outside world, for which acoustic labels were invented to form nouns; actions for which verbs were devised; and the development of a high degree of motor skill to emit the sounds. Nor could speech and music be created and appreciated until hearing had been enriched with a fuller meaning than is implied in the mere understanding of emotional cries, in instinctive responses to, or imitations of, cries that have been heard.

A mould of the brain-case of the earliest and most primitive member of the human family at present known to us (*Pithecanthropus*) reveals a very conspicuous and precocious expansion of an area precisely corresponding in position to the part of modern man's brain which is concerned with the appreciation of spoken

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language. The only inference is that speech is as old as man himself. The acquisition of articulate language conferred the rank of humanity upon a simian ancestor. The powerful instrument of speech completely transformed man's mode of behaviour. It made him dependent on his fellows for knowledge, and subjected him to the influence of their erroneous interpretations of their experience.

Man has the seeing eye, the understanding ear, and the skilful hands to shape his own destiny. It is important to get a clear idea of what is involved in the vast increase in man's intellectual abilities when he sees, hears and feels. The instrument that confers upon man his intellectual supremacy is the part of the cerebral cortex known as the neopallium, which attains an important functional significance only in mammals. It is essentially the ultimate destination of these impulses from the eyes, skin and ears that enables us to understand what we see, hear and feel; to associate three kinds of sensory experience so that we can appreciate the various properties of an object which appeals to one or more of three senses, and to compare our present impressions with similar or contrasted incidents in the past.

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