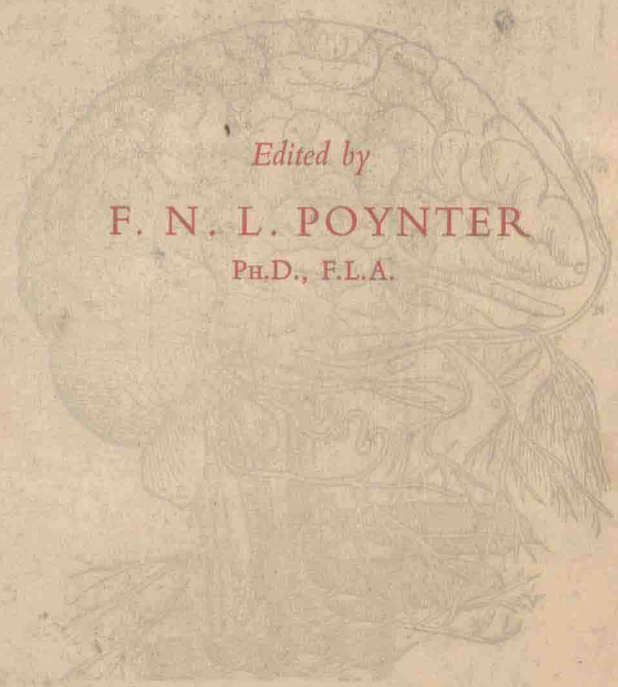


*The History
and Philosophy of Knowledge of*
THE BRAIN
AND ITS
FUNCTIONS



Edited by
F. N. L. POYNTER
PH.D., F.L.A.

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The History and Philosophy of Knowledge of

THE BRAIN AND ITS FUNCTIONS

An Anglo-American Symposium

London, July 15th-17th, 1957

Sponsored by the Wellcome Historical Medical Library
with the co-operation of the National Hospital,
Queen Square, and the Institute of Psychiatry
(University of London) at the Maudsley
Hospital, Denmark Hill

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FOREWORD

The Anglo-American Symposium at which the papers in this volume were presented was inspired by Dr Horace W. Magoun (University of California) and Dr Robert B. Livingston (National Institutes of Health, Bethesda, Md.) and was planned as an historical introduction to the First International Congress of Neurological Sciences held at Brussels, July 21st to 28th, 1957. The Congress Planning Committee in the United States considered that London would be the most appropriate city for such a symposium and that the Wellcome Historical Medical Library would be the most appropriate institution to sponsor and organize it and it was therefore invited to do so. This Library, which is well known in medical circles throughout the world, actually forms part of The Wellcome Foundation Ltd., and the Board of Directors readily agreed that the invitation should be accepted. The Librarian, Dr F. N. L. Poynter, formed an organizing committee in London consisting of Sir Russell Brain, Dr Macdonald Critchley (Chairman), Sir Geoffrey Jefferson and Professor Aubrey Lewis, with himself as Secretary, and this committee was soon assured of the willing co-operation of the National Hospital and of the Institute of Psychiatry at the Maudsley Hospital. Advice and help was given by a parallel American committee consisting of Dr Mary Brazier, Dr Webb Haymaker, Dr Robert Livingston, Dr Horace W. Magoun, Dr James L. O'Leary, with Dr Pearce Bailey as Chairman. By prompt action and enthusiastic co-operation from all concerned it was possible to produce a complete programme within three months. It was decided that attendance should be by invitation only and about seventy neurologists, psychiatrists, medical historians and philosophers were enrolled. It was a matter of regret to all that Professor John F. Fulton of Yale University, who had taken a special interest in the Symposium and to whom both national committees were indebted for help and advice, was forced by illness to return home just before its opening.

As Chairman of the Wellcome Foundation, I had the privilege of greeting the delegates in the Auditorium of the Wellcome Building and of introducing His Excellency the United States Ambassador in London, Mr John Hay Whitney, who had consented to open the special Symposium Exhibition. On that occasion I was able to

explain to my audience certain unique features of the Wellcome Foundation which had made it possible for the Wellcome Historical Medical Library to sponsor such an event and for its Librarian to spend so much time in its organization. The Foundation had its origin in a partnership set up in 1880 by Silas M. Burroughs and Henry S. Wellcome under the style of Burroughs Wellcome & Co. to manufacture and sell pharmaceuticals. Following the early death of Burroughs, Wellcome became sole owner and he devoted much of his later life to setting up museums and a library which were maintained from the profits of the business. He consolidated his many interests in Great Britain and overseas, including his Historical Museum and Library, into one private company in 1924 and this was registered under the name of The Wellcome Foundation Limited. On his death in 1936 all the shares in that Company were vested in a body of trustees known as the Wellcome Trust. As sole shareholders in the Foundation the trustees are directed under Wellcome's will to use the distributed profits which they receive as dividends from The Wellcome Foundation Limited for purposes which can be defined broadly as the advancement of research in medical and allied sciences. Sir Henry Dale, both as Chairman of the Wellcome Trust and as one who has long had cordial and fruitful contacts with scientists in America, was happy to accept the invitation to propose the toast of 'Anglo-American co-operation in science and medicine' at the dinner which concluded the meeting. His address is published at the end of this volume which Dr Poynter has edited and seen through the press. The spirit of that address is one which we, on both sides of the Atlantic, must do all in our power to foster, and it is occasions such as this Symposium which provide the ever strengthening bond between us. To all those individuals and institutions, committees and speakers, who did so much by their enthusiasm and practical co-operation to make this meeting an outstanding success I extend my thanks.

MICHAEL W. PERRIN

Chairman, The Wellcome Foundation Limited

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WELLCOME AUDITORIUM

Chairman: WILDER PENFIELD

Speakers

D. H. M. WOOLLAM

J. S. WILKIE

ILZA VEITH

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HIPPOCRATIC PREAMBLE: THE BRAIN AND INTELLIGENCE

WILDER PENFIELD

It is my privilege to open the formal session of this Symposium on the 'History and Philosophy of Knowledge of the Brain and its Functions'. In so doing, I propose to introduce an additional speaker, one not listed on your programme, although he might well speak out during the discussions. I refer to Hippocrates. What physician is better qualified to raise the curtain on these proceedings?

Hippocrates was born in the year 460 B.C., the year in which Pericles came to power in Athens. He lived in the golden classical era, during which the Greeks, in the cities that dotted the shores of the eastern Mediterranean, made their greatest contribution to our civilization. All through that outburst of intellectual activity, they excelled in drama, poetry, music, architecture, sculpture, painting, mathematics, history and, above all, in philosophy.

But there had been, no doubt, a long period of preparatory growth, though we know so little about it. The roots and lusty stems of Grecian culture must have been old in Hellas before genius could come to final flower in so many fields. Surely this was the case in regard to medical practice. The physicians, who called themselves Asclepiads, claimed continuity of professional inheritance for seven centuries and no doubt the claim was valid.

There can be no reasonable doubt that Hippocrates of Cos became, in his day, the leader of thought among the Asclepiads, especially those of Cos and Cnidus. One might doubt the legend that he was a direct descendant of Hercules on his mother's side and of Asclepius through his father. There may be doubt, also, as to which books of the Corpus Hippocraticum came from his pen. Some might even assume that, as Socrates speaks to us through the writings of Plato and of Xenophon, so Hippocrates speaks through his disciples. Perhaps Dr Woollam will have a word for us on this subject. But, for me, Hippocrates was clearly the greatest physician of his time. Socrates and Aristotle were obviously of the same opinion.

The symposium is an ancient institution. The Greeks used it to provide an evening of directed discussion. Hippocrates must have

planned many of them. He might well have organized one on the history of medicine looking back across the centuries to the time when Asclepius was a mortal practitioner, and his earthly sons were 'cunning leeches' serving King Agamemnon before the walls of Troy.

To such a symposium at his home in Cos, he would doubtless have invited physicians from the oldest centre of medical teaching, located at Cnidus. Cos and Cnidus were separated from each other by no more than an afternoon's sail across the blue water of the Aegean. Euryphon, the Cnidian gynaecologist, would certainly have come and he might have brought young Ctesias with him, Ctesias who was to spend his mature life as physician to the Kings of Persia. Perhaps the poet-physician Empedocles, who was so long an exile from his home in Sicily, might have joined them. Herodotus, the historian, might well have been invited when he was returning to visit the near-by city of his birth, Halicarnassus.

The classical scholar, W. H. S. Jones, has selected certain books* of the Corpus Hippocraticum as those written by a genius, presumably Hippocrates. The author stood out staunchly for the independence of science as against superstition and against the application of unprovable hypotheses to natural science. Physicians, the author said, must observe natural phenomena, record the action of disease on patients, and refuse to yield to the dangerously soaring rationalizations of the philosophers.

However, the finest concept of the brain and its function is to be found in another book, called *The Sacred Disease*. Jones suggests that this one was written for a lay audience. Whether or not that is so, I can only say that, from the point of view of a neurologist, it contains antiquity's best discussion of the function of the brain. It is a magnificent statement that could only have been written by a physician who had studied epileptic patients and their seizures. There is nothing in medical writing to compare with it until Hughlings Jackson began to use the same method, looking upon epileptic seizures as illuminating experiments carried out by disease upon the brain.

But I shall let Hippocrates speak out by selecting a few excerpts from this book of his on epilepsy.†

* Epidemics I and III, Prognostic, and Regimen in Acute Diseases.

† HIPPOCRATES [*Select works*]. With an English translation by W. H. S. Jones. (Loeb Classical Library.) London, Heinemann, 1923-31. Vol. II, pp. 139-83 (*The Sacred Disease*).

'I am about to discuss', he wrote, 'the disease called "sacred". It is not, in my opinion, any more divine or more sacred than other diseases, but has a natural cause, and its supposed divine origin is due to men's inexperience, and to their wonder at its peculiar character.'

'In these ways, I hold that the brain is the most powerful organ of the human body, for when it is healthy it is an interpreter to us of the phenomena caused by the air, as it is the air that gives it intelligence. Eyes, ears, tongue, hands and feet act in accordance with the discernment of the brain. . . .'

'Wherefore I assert that the brain is the interpreter of consciousness.'

'Some people say that the heart is the organ with which we think, and that it feels pain and anxiety. But it is not so. . . .'

'Men ought to know that from the brain, and from the brain only, arise our pleasures, joys, laughter and jests, as well as our sorrows, pains, griefs and tears. Through it, in particular, we think, see, hear, and distinguish the ugly from the beautiful, the bad from the good, the pleasant from the unpleasant . . . It is the same thing which makes us mad or delirious, inspires us with dread and fear, whether by night or by day, brings sleeplessness, inopportune mistakes, aimless anxieties, absent-mindedness, and acts that are contrary to habit. These things that we suffer all come from the brain, when it is not healthy. . . .'

This was a great step forward in the fifth century before Christ, and one that was forgotten or ignored by the philosophers and physicians who followed him. During the twenty-four centuries since Hippocrates men have learned much about the mechanisms of brain action. You would probably substitute the word oxygen for air in the foregoing quotation. And yet, if our goal is to understand the relationship of brain to mind, it would seem that Hippocrates stood about as close to that goal as we. 'The brain', he said, 'is the interpreter of consciousness.'

Dr Gordon Holmes wrote* recently: 'The claim of Hippocrates that knowledge comes only from direct observation, observation controlled by experiment, remains today the essential basis of our science.'

* Personal communication.

In this symposium, we are called upon to take the long view of history. Let us, then, turn to wisdom knowing that, as knowledge nears its ultimate goal, each individual effort will lose its signature in the 'corpus' of our common effort. And Time, returning to this shore, will wash away the patterns of our present thinking, like 'foot-prints in the sands'.

CONCEPTS OF THE BRAIN AND ITS FUNCTIONS IN CLASSICAL ANTIQUITY

D. H. M. WOOLLAM

The classical historian wishing to make for himself a mental picture of the material environment which surrounded the great figures of the ancient world does well to visit Egypt, Greece or Rome. There, from the broken crumbling pillars, from fragments and shards of pottery, and, in greater comfort, perhaps, from the long lines of trays and show-cases in museums, he is able to rebuild in his mind piece by piece the backcloth against which his subjects acted out their lives.

It is our good fortune that our pilgrimage does not need to be anything like so extensive. For, unlike the Colosseum or the Parthenon, the brain has undergone no changes with the passing of the years, and it comes into our hands today as fresh and as new as it did into the hands of Herophilus or of Galen. But, and this is the central theme of my paper, although our task of reconstruction is so much easier than that faced by the classical historian, we make things very difficult for ourselves if we fail to look, and look repeatedly, at the brain in the one form in which it was known to the ancients. For it was the fresh unpreserved brain with which alone they were familiar, and the brain preserved in formalin, on which so much of our modern anatomical ideas are based, bears very little resemblance to the brain that Galen and Herophilus knew.

If we are to imagine ourselves as looking at the brain in precisely the same way as the ancients did, we must first realize that very rarely, and often only with the utmost indifference, will we be looking at the human brain. Yet we shall seldom be in any doubt when we are dissecting the brain of animals other than man that the information we obtain is readily transferable to the human brain. The animal we will be concerned with chiefly is the ox, for both Herophilus and Galen based their neuroanatomy on the dissection of the brain of this animal. Somewhat ironically, it was a good deal easier for Galen to obtain an ox brain in an undamaged condition than it is for us today in this country. 'Ox-brains totally prepared', he wrote, 'are to be had in all the large towns', and, in repeating his dissections, I looked back

with envy, if not with anger, to a time when it was possible to obtain a fresh ox-brain undisturbed by the humane killer.

It is in reality the greatest tribute we can pay to the illustrious names of the ancient world to judge them by our own contemporary, and that means *scientific* standards. For as Hazlitt has finely put it, 'Fame is the inheritance not of the dead but of the living. It is *we* who look back with lofty pride to the great names of antiquity, who drink of that flood of glory as of a river, and refresh our wings in it for future flight'.

Yet the great scientific names of the ancient world, Aristotle, Democritus, Galen and Hippocrates have received so much tribute, that it is easy to fall into the belief that all our modern scientific knowledge already existed in embryo as it were in the ancient world. To take but two examples. Hippocrates described how a blow on the head could produce paralysis of the opposite side of the body. It is not too difficult to fall into the trap of reading backwards from our knowledge of the anatomy of the brain and see in this statement the first reference to the crossing of the pyramidal tracts. The study of the knowledge of the anatomy of the brain displayed in the Hippocratic Corpus proves a salutary corrective to this view, and respect for the clinical acumen and wisdom of Hippocrates remains unaffected.

Again, Erasistratus is said to have taught that fast running animals, such as the hare and deer, had more intricately folded and extensive cerebellar folia than their less active brethren. Some authorities have seen in this observation of Erasistratus the first reference to the role of the cerebellum in the maintenance of the posture of the body, and have investigated the comparative anatomy of the cerebellum in an attempt to prove or disprove his statement. If we look at the brain of a common fallow deer, and compare it with the brain of an ox, we cannot see any indication that the differences in fleetness of foot of these animals is in any way reflected in the formation of the cerebellum. Indeed if one wishes to clinch the matter one cannot do better than look at the brain of the two-toed sloth, an animal of proverbial indolence, who passes his life, as Sydney Smith remarked, 'in a state of suspense — like a young clergyman distantly related to a bishop'. His cerebellum, nevertheless, is every bit as convoluted as that of the two types of deer. Although it is easy, therefore, to prove or disprove the *statement* of Erasistratus, he remains the first man to apply comparative methods to the brain, and as such merits our respect as the father of comparative neurology.

The first references we have to the structures inside the skull come from the Egyptian civilization, and the story of the brain in classical antiquity starts with the Egyptian method of preserving their dead by embalming which they practised from about 4000 B.C. Herodotus gives a good account of the removal of the brain prior to the embalming of the body.

They first take a crooked piece of metal, and with it they draw out the brain through the nostrils, thus getting rid of a portion, while the skull is cleared of the rest by rinsing with drugs.

This rather cavalier treatment of the brain reflects perhaps the indifference of the Egyptians to the brain, an indifference which contrasts with their reverence for the heart and diaphragm as the seat of the soul. The small account of the brain relative to the heart and diaphragm is also perhaps shown by the fact that the *paracentetes*, the men who made the incision in the abdomen in the preparation of the mummy were forced to flee for their lives when their task was completed, whilst, as far as we are aware, no such fate awaited those who scooped the non-taboo brain out like porridge through the ethmoid bones and nose. Not surprisingly perhaps, the Egyptians did know the meninges, and there is a reference to these membranes, or more probably to the dura only, in the Edwin Smith Surgical Papyrus, which is a copy made in 1700 B.C. of a manuscript composed about 3500 B.C.

When we leave the Egyptians and turn to the Hellenic world, we immediately think of Homer as a source for Greek ideas of the brain. We find that Homer also puts the seat of the emotions in the heart, the liver and the diaphragm, and pays but little attention to the brain. He knew the position of the brain inside the cranial cavity and of the spinal cord inside the vertebral column, but very little else, and he used the term 'nerve' to describe all the fibrous tissues of the body.

It is Alcmaeon of Croton, living in the fifth century B.C., who emerges as the first important figure in the history of the brain. His chief contribution was to place the site of sensation firmly in the brain. He practised apparently not only dissection but also vivisection and, unlike Parmenides and Empedocles, distinguished clearly between thought and sensation, observing that all animals feel, but only man thinks. His chief anatomical discovery was that of the optic nerves, and he believed that the impression made on the eye by external objects was transmitted to the brain by the optic nerves

which he regarded as hollow canals. This idea that the nerves were hollow was of considerable influence later and derived probably from the presence of a subarachnoid space along the optic nerve. Perhaps the most remarkable of Alcmaeon's postulates was his concept that each sensation had its own territory of localization in the brain, a concept that was not seriously revived for twenty-five centuries after his death.

Although, as I shall be stressing later, there were those who denied that the soul and centre of the sensations resided in the head, by the middle of the fifth century B.C. this idea was well established. Plato and Theophrastus, Democritus and Diogenes all laid stress on the brain as the focal centre of the body's activities. Plato, of course, subscribed to the idea that there was a triple organization of the soul, with the appetites located in the midriff, passion in the breast, and the reasoning soul alone in the brain. If we put ourselves in the position of Plato for one moment all we can know for certain of the brain is that it is a putty-like mass contained within the skull. If we have been to a performance of Aristophanes's play *The Frogs* we will know also that this mass is surrounded by membranes, for a character in that play refers to the 'two meninges of the brain'. Yet on this slender basis of anatomical knowledge Plato built up a concept of the brain so bizarre that I can best explain it by quoting fully from the translation by Dr Benjamin Jowett:

God took such of the primary triangles as were straight and smooth, and were adapted by their perfection to produce fire and water and air and earth; these, I say, he separated from their kinds, and mingled them in close proportions with one another, made the marrow out of them to be a universal seed of the whole race of mankind, and in this seed he then planted and enclosed the souls. . . . That which was to receive the divine seed, he made round every way and called that portion of the marrow *brain*, intending that, when an animal was perfected, the vessel containing this substance should be the head.

It is interesting to note how the speculative temperament of Plato builds on the scanty anatomical knowledge of his time, and erects this strange system of embryological belief, whilst the essentially *biological* approach of Alcmaeon is illustrated by his statement that 'the head is formed first in the embryo because the brain is lodged in the