

Blood-brain barrier

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The Concept of a Blood-Brain Barrier. By Michael Bradbury. Pp.465. (Wiley: Chichester, UK, and New York, 1979.) £22.

THIS book by Michael Bradbury, of King's College, London, is a scholarly, comprehensive and readable analysis of past and recent studies on the blood-brain barrier (BBB) by a researcher who has made major contributions to the field. It extends the important review by Davson (*Physiology of the Cerebrospinal Fluid*, Churchill, Livingstone: Edinburgh, 1967) and complements, with only slight overlap, my own book (*Blood-Brain Barrier in Physiology and Medicine*, Raven: New York, 1976). It contains more than 1,000 references, and should be of value to researchers as well as to neuropharmacologists, neurochemists, neurosurgeons, neurologists and transport physiologists.

The BBB separates the brain and cerebrospinal fluid (CSF), on the one hand, from blood on the other, and is a regulatory system consisting of three tissue sites — the cerebrovasculature, the choroid plexus and the arachnoid membrane. Each site contains at least one cell layer that is connected by tight junctions (which restrict intercellular diffusion of water-soluble drugs and proteins) and that has specific transport mechanisms that help to regulate the ionic and water contents of the brain, and to facilitate delivery to the brain of critical substrates for metabolism and synthetic processes.

Chapter 1 introduces the anatomical and functional relationships between barrier tissue sites and brain cells. Chapter 2 summarises early studies on the barrier to intravascular dyes and colloids, and presents methods of compartmental analysis that can be used to estimate cerebrovascular permeability. The vasculature is selectively permeable to lipid-soluble as compared to water-soluble agents. Chapter 3 reviews historical controversies about BBB sites, and shows that the BBB at the cerebral vasculature arises at the continuous layer of endothelial cells that have little pinocytosis and are connected by tight junctions. The chapter also analyses methods of measuring cerebrovascular permeability *in vivo*, and discusses capillary hydraulic and water permeability. Bradbury concludes that functional pores exist at the vascular endothelium for non-electrolyte diffusion, although I believe that evidence suggests that they do not. The sink action of CSF, in washing material from the brain extracellular space, is discussed.

Chapter 5 indicates that apparent regional differences in blood-brain exchange reflect differences in capillary surface area between white and grey

matter. It considers the special, high permeability regions in the brain in detail (that is, median eminence, posterior pituitary), which have vessels with porous, fenestrated endothelia and have neuroendocrine and chemoreceptor functions. Blood vessels in the retina, optic nerve and peripheral nerve also have a continuous endothelial lining.

Chapter 6 elaborates the properties of saturable, stereospecific mechanisms at cerebral capillaries for facilitated diffusion of sugars, amino acids, ketone bodies and monocarboxylic acids. Bradbury suggests that amino acids are transported actively from brain to CSF, although the evidence for this is weak. Chapter 7 critically evaluates experiments designed to prove active transport at the cerebral capillary, and finds most of them wanting. The best one is that by Davson and Hollingsworth with ^{131}I .

Chapters 8 and 9 summarise much of Bradbury's original studies on homeostatic regulation of ions within the nervous system. The apparent selectivity of the cerebral capillary to K^+ as compared to Na^+ could be due to active K^+ transport or to exchange diffusion of K^+ . Transport at the choroid plexus maintains CSF concentrations of Ca^{2+} , Mg^{2+} , Na^+ and K^+ within strict limits, despite marked changes in plasma concentrations. A sigmoid relationship between CSF K^+ and K^+ efflux at the plexus, and a K^+ -independent influx, could stabilise CSF K^+ . Brain and CSF pH are also stabilised through modification of choroidal secretions and brain organic ion content (especially in alkalosis). Control of brain ionic content helps to maintain a

constant brain volume during a chronic change in plasma osmolality.

BBB phylogeny is discussed in Chapter 10. BBB structures are in place but are less tight in the immature than in the mature brain. Regulatory mechanisms for specific ions mature at different rates, but are completely developed during the final spurt of brain growth.

Chapter 11 discusses the BBB to drugs, neurotransmitters and metabolites. Most current methods are not sufficiently sensitive to measure capillary permeability of slowly permeating agents, such as peptides. Clinical depression and schizophrenia are related to CSF concentrations of specific neurotransmitters or their metabolites. CSF concentrations of folic acid, vitamin C, peptides and morphine are regulated by choroidal transport.

Chapter 12 summarises effects of different insults on BBB permeability — hypercapnia, seizure, hypertension, toxic agents, hypertonic solutions. Bradbury concludes that the possible mechanisms that might increase cerebrovascular permeability — tight junctional widening, increased vesicular transport, trans-endothelial channel formation — remain to be evaluated critically. The resistance of the BBB to hypoxia and ischaemia is emphasised, as are principles underlying cerebral oedema. Chapter 13 summarises overall BBB function. A final proof reading of the book would have avoided a few trivial errors. □

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Birdwatching postscript

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The Mitchell-Beazley Birdwatchers' Pocket Guide. By Peter Hayman. Pp. 192. (Mitchell-Beazley/RSPB: London, 1979.) £3.95.

THIS is a slender, wallet-sized book which can be conveniently carried with one into the field. It is crammed full of coloured sketches, most of which are very small (less than an inch across), but they usefully portray the birds in a variety of plumages and poses (perched and in flight) and from different angles. Juvenile plumages are also often shown, though I would have preferred more of these to have been included.

The text is very sparing but includes the most important features of each species, their calls, their habitats, and range. Some of this information is given in the form of

symbols, thereby saving space. There is also usually a small silhouette of each species against that of either a sparrow or a pigeon in order to give a quick idea of size. This is not a total success; when the bird in question is very large compared with scale model (for example, pheasant with sparrow or eagle with pigeon) the model may be less than 2 mm in size. In such cases, the poor reader is left to determine which of these two models this tiny spot of ink is supposed to represent!

The book covers some 350 species and hence includes almost all the birds of Western Europe. More detail is given for those which are commonest in Britain than for the rarer birds; the latter are sometimes grouped together on a page and so are not located with their closest relatives. The order used is not an accepted taxonomic one, but one designed to help the beginner locate the species concerned. On the whole this is a well produced, highly portable little book which many will find very useful. □

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