V.L. BIANKI, *The Right and Left Hemispheres of the Animal Brain* (Gordon and Breach Science Publishers, London, 1988) pp. xvi + 423, $84.00.

The author has been working on hemispheric functional asymmetries in animals since 1956, in the Institute for Biology at Leningrad State University: the references include almost 100 published papers under his name, the majority from the 1970s. The book is a systematic summary of this work, together with a thorough review of Western studies, and a theoretical conclusion. The first chapter briefly recounts theories of human cerebral asymmetry, from Broca, Wernicke and Jackson to Sperry, Gazzaniga and Bogen and their modern Russian equivalents. The second reviews phenomena of individual as opposed to species-specific asymmetries in animals, including "pawedness" and individual sensory and motor biases. The next three chapters make up the bulk of the book and report a mass of data which it is claimed prove the existence of species-specific lateralization of function in animals, using rats and cats as subjects. The major physiological techniques used are *spreading depression* (SD) and *evoked potentials* (EP).

SD, used in other contexts by Bures and Buresova in the 1960s, is certainly an appropriate tool for examining hemispheric specialization in animals, since it can produce what amounts to a reversible functional hemi-decortication. Placing a 1-mm square piece of filter paper moistened with KCl on the cortical surface substantially inhibits cortical activity of the whole hemisphere for several hours. Therefore a general experimental design is to train animals to a certain level of proficiency on a given task, and then inactivate one or other hemisphere, assessing its involvement according to the performance decrement. In most cases each animal received the SD treatment on each hemisphere separately, the side treated first being counterbalanced.

The range of tasks examined in this way in rats includes: shuttle-box avoidance; door-pushing avoidance; food-reinforced door-pushing discriminated according to geometical shapes projected onto the door; door-pushing under complex routines of parietal reinforcement; detouring round a screen (Kruchinsky's "extrapolation" task); discrimination of (Russian) speech sounds; open-field activity; avoidance of pain-induced vocalization in other

rats; intra-cranial self-stimulation; visual discrimination with added visual noise; temporal discriminations; and radial maze performance. It is claimed that in all these cases species-specific functional asymmetries are observed, but the results are not straightforward.

There is first the problem of negative results – many experiments in other laboratories, and many of Bianki's own, fail to reveal asymmetries of hemispheric functioning in animals. Bianki lists five main factors which he believes contribute to negative results. (1) Several of his own early experiments used split-brain preparations in order to assess hemispheric functioning independently, but later experiments suggest that corpus callosum sectioning in animals has the effect of severely reducing functional asymmetries. (2) Large numbers of animals are needed in order for results to reach statistical significance. (3) Monkeys and cats are in any case more ambilateral than rodents. (4) Not all tasks should be expected to reveal functional asymmetries. (5) There are sex differences in asymmetry. These are not implausible factors, although if true they would detract somewhat from the utility of animal results as models of human functional asymmetry. However, Bianki does not address the issue of possible Type II errors in the occasional positive results, which should therefore be interpreted with caution.

The most general feature of the positive results is a shift from right to left hemisphere dominance in the course of learning: in most conditioning and discrimination tasks inactivation of the right hemisphere by spreading depression leads to greater decrements in performance in the early stages of learning, while in the later stages if any asymmetry was observed it took the form of greater decrements with the left hemisphere disabled. There did not appear to be much regularity in the direction of sex differences: females had no final left dominance of shuttle-box avoidance (p. 47), but greater left dominance of stable speech sound discrimination (pp. 88–91). Radial maze performance seemed relatively insensitive to which hemisphere was disabled by spreading depression, but the differing effects of left and right hemisphere deactivation on various visual and auditory discriminations should attract attempts at replication.

The evoked potential (EP) work was done mainly with cats. Bilateral stimuli of various modalities were presented and EP recordings made from hundreds of symmetrically opposite points of sensory cortex, this mapping being repeated after corpus callosum sectioning (p. 230). Asymmetries could be observed in the magnitude of response at symmetrically opposite points in the two hemispheres and/or in the location of responding sites. However, it is said that about a third of all animals show no form of EP asymmetry at all, and no species-typical left–right differences were observed in auditory or sensorimotor areas. The only systematic difference claimed is a significantly greater magnitude of response to visual stimuli in the visual cortex (areas 17 and 18) of the right hemisphere. After corpus callosum sectioning there is a

reduction of this difference, and of the differences which vary from animal to animal in the EP recordings from auditory and sensorimotor cortex in the two hemispheres. Further data are presented supporting the existence of inter-hemispheric interactions, but the discussion in terms of the theory of "dominanta" will be obscure to Western readers.

This by no means exhausts the range of data presented here. Of the rest one notes a controversial claim that cats and certain strains of hybrid mice (though not rats) have a population preference for the right paw in a food-reaching task (p. 135) but this is weakened by the fact that for similar experiments performed at the same time mice were reared in asymmetrical home cages (p. 207). These were studies which confirm previous reports that the direction of forepaw preference is not affected by selective breeding.

The overall theoretical conclusion in is the form of "the inductive–deductive hypothesis". The results are said to suggest that the right animal hemisphere carries out mainly spatial and simultaneous information processing, while the left processes successive and temporal information. In Pavlovian terms, the right does synthesis first and then analysis, the left analysis first and synthesis second: the right is deductive and the left inductive, and these more general principles underlie human brain lateralization. But I suspect the main value of this book for Western readers will be as a source of an enormous amount of data which is otherwise relatively inaccessible. (Bianki politely and correctly points out that in a review I published in 1980 all data obtained in the Soviet Union were totally overlooked). There are 10 tables and 77 figures, the translation is clear, and the book is well produced. There will thus be even less excuse in future for English-speaking investigators not being as familiar with Russian data as Bianki is with theirs.

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