techniques of the subject and yet fail to understand what topology is. Patterson's book is much smaller and therefore omits more, but takes great pains to give ideas the preference over technique.

In Hall and Spencer, we start with a certain amount of classical set theory and analysis, with a topological motivation, and proceed to a neat characterization of topological spaces, followed by a special study of metric spaces. Most of this has an analytical flavour; but the next chapter, the longest in the book, is rather more geometrical, analysing the nature of arcs, Jordan curves, and the concept of local compactness. This section is detailed and clear, as befits a topic of such basic importance. The following section, on Bing's recent work on partitionability, is less easy to assimilate, and being highly technical is almost out of place in a professed introduction. The final chapter is in the nature of an appendix on the axiom of choice and the equivalent lemma of Zorn. There is a good collection of examples, easy and not so easy, for the student, and a useful short bibliography is attached to each chapter. The road everywhere has a good surface, but more signposts would help the novice.

Patterson begins with simple concrete ideas: topological equivalence, one-sided and two-sided surfaces, Euler's theorem on polyhedra, the four-colour problem. Then a little set-theory leads to metric spaces, which in turn lead to the more general topological space. The homotopy problem, of continuous deformation of one sub-space into another, is clearly described. Then algebraic topology, practically ignored in the Hall and Spencer volume, is developed in two chapters, one on simplexes, the next on homology. The latter is perhaps too concise for ready understanding, and might well be expanded in a new edition. There are a fair number of exercises for the reader. The great merit of the book is that it tells the reader what topology is about, in clear and generally simple language; it will help not only the undergraduate but also the non-topological mathematician who wants to know what topology is and why it is important. T. A. A. BROADBENT

## THE MIND–BODY PROBLEM

### The Biology of the Spirit

By Dr. Edmund W. Sinnott. Pp. ix+180. (London: Victor Gollancz, Ltd., 1956.) 16*s*. net.

DR. E. W. SINNOTT has written one more essay on the perennial mind–body problem, but this would be an unfair way of describing what he has given us, because it is distinctly original in character and, owing to the point of view from which it is written, opens out wide issues. His book may, in fact, be said to begin with protoplasm and end with beauty, goodness and God. The main thesis of the essay is that the basic facts of biology provide a common foundation for both mind and body.

Dr. Sinnott is not a vitalist, though he considers that the facts on which Driesch based his vitalist theory have not been, and probably cannot be, interpreted by a mechanistic hypothesis. He rejects the view that biology can understand living processes by employing solely the concepts which are adequate in physics and chemistry. One of his two master words is 'organism', and the chapter in which he expounds this conception and the reasons for regarding it as fundamental are clear and well argued. In this section of the book, the central problem is that which Walter de la Mare once stated in the words, "Why does what Miss T. eats become Miss T. ?" and is essentially the same as that which Aristotle tried to solve in his philosophy of matter and form. "A living body is not an aggregate but an integrate" and in it the whole is, in some way, immanent in the parts. The other master word in Dr. Sinnott's essay is 'purpose'. He holds that it is misleading to think of living creatures being "propelled by drives", and we have a more accurate picture when we regard the forces as 'pulls'. He describes his own view as telism, the philosophy of goals—"a belief that what is important is not the push and drive of a living system but a drawing power to a goal conscious or unconscious that in some way is established in it". The later chapters of the book deal with the development of the human individual and goals and purposes which have emerged in human personality. In his view, the process by which protoplasm and spirit are linked together is a continuous one, but in its course a new level of life is attained.

In the final chapters, which the author undoubtedly regards as the most important, we are, of course, in the region of philosophy, and he does not pretend that he can give a scientific proof of his conclusions. He argues, however, that a survey of the phenomena of life in their whole range strongly suggests that the organizing and forward-moving qualities found in life indicate the nature of reality and help us to link our values and our faith in God with biology. "If all the goal-seeking, desiring, and aspiring of our spirits are but curious tensions in a protoplasmic mechanism, they are still of interest and importance in many ways; but if, beyond all this, they provide a means of communion with something in the universe that can be apprehended in no other way, then does their significance indeed transcend all other human qualities."

Dr. Sinnott believes that the fundamental problem is the nature of life and that, by concentrating on this, we may hope to reach an understanding both of matter and of mind and of their relations with one another. It cannot be said that Dr. Sinnott has done much more than point a possible way and made some important observations. Matter and mind, thought and things remain obstinately different, but it may well be that the solution lies along the way which he has pointed out. W. R. MATTHEWS

## BRAINS: REAL AND ARTIFICIAL

### Automata Studies

Edited by C. E. Shannon and J. McCarthy. (Annals of Mathematics Studies, No. 34.) Pp. ix+286. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1956.) 32*s*. net.

THIS volume contains some dozen essays, by American and European authors, on the general theme of brain models. The work is mainly mathematical in character, and presents the opinions of well-informed, and mostly well-known, writers in the field whose general aim is to answer the question: "How does the brain work ?" so far as this can be answered within the limits of modern scientific knowledge. Such knowledge is contributed from