purpose is primarily philosophical, to develop a mode of approach to the problems of biology. However, its method, perhaps wisely, is not dialectical; instead of presenting a close train of argument, Dr. Russell indicates, by descriptions of actual examples, what he means by "directiveness". Look, he says, at this regenerating flatworm or developing egg; naïvely beheld, they cannot but seem to strive towards a well-recognized completeness, which is their goal. Consider again the ability of rats to choose, from an array of purified substances, just those which together make up a perfect diet; or the fact that a rabbit, which reacts to a loss of blood by rapidly making more, and to the transfusion of extra blood by getting rid of the excess, nevertheless does neither of these when the loss is rapidly followed by a transfusion; is it not clear, Dr. Russell asks, that it is the need of the organism, rather than any mere physico-chemical stimulus, which determines the animal's behaviour?

The examples are not always convincing. For example, rats may, as is asserted, be able to pick out for themselves a perfect diet, though the matter is still, I believe, under discussion; but there is no doubt that many other animals cannot. Again, it is difficult to see why, on any reasonable hypothesis, a rabbit should show any marked reaction to an experimental series of bleedings and transfusion which end by restoring the *status quo ante*. But undoubtedly, Dr. Russell can adduce many remarkable biological phenomena which, as he puts it, "are directive towards ends of self-maintenance, development or reproduction". It is difficult not to admit some degree of astonishment at the performance of the minute worm *Microstoma*, which eats *Hydra*, digests all but the sting-cells (nematocysts), and from these selects the varieties with the greatest offensive power (rejecting the other sorts through the mouth), and finally arranges to shuffle these captured weapons through the thickness of its body wall until they reach the surface, where their captor can use them for its own purposes. Such things, to use a cliché, would seem to demand an explanation.

The most unsatisfactory feature of Dr. Russell's book is that he makes no attempt to provide an explanation in other than self-consciously "biological" terms, or even to discuss the explanations which most biologists nowadays advance. "As a philosophy materialism is merely absurd," he asserts, "why then base biology upon it" (p. 2). "For such understanding we require a free biology, with laws and concepts of its own, independent of those of the physical sciences, based upon an objective study of the directive activities of organic agents, unrestricted by the hampering mechanistic hypothesis which is at the back of the causal-analytical method" (p. 4). It may be granted that, whatever a "free biology" may be, specifically biological laws may be quite useful tools of thought. Even the application of straightforward teleology is a quick rule of thumb which often works. And biologists, still without reaching the domain of physics, can rely on a much subtler form of explanation, the appeal to natural selection and the gene.

Russell scarcely mentions either of these fundamentals of biological thought. His only reference to the gene is to classify studies on "the presumed action of genes on development" among the "analytical and disintegrative" physico-chemical investigations which miss the point of "the organism as a living, developing, reproducing whole" (p. 2). This is odd; not only because he allows (p. 158) that those other, one would have thought equally mechanistic, agents, evocators and growth-hormones, do contribute to "a biological account"; but even more because the modern view of an organism in terms of its genes would seem much more closely akin, philosophically, to his own ideas than was the usual biological picture of, say, thirty years ago. In his summing up, Russell applies to the living organism a saying of Spinoza's: "The effort by which each thing endeavours to persist in its own being is nothing else than the actual essence of the thing itself". As we should put it: the actual essence of the thing itself is to be found in the genes which control its synthetic activities, and which, being capable of maintaining their own specificity by self-reproduction, direct this synthesis always into the paths which are characteristic of that particular organism.

Thus an outlook which stresses that development and self-maintenance are essential characteristics of organisms is in no way in opposition to current biological thought; but that body of thought has already gone further than Dr. Russell in relating these aspects of life, through the concepts of the gene and of natural selection, to the rest of Nature.

C. H. WADDINGTON.

TREES AND FUNGI

Trees and Toadstools

By Dr. M. C. Rayner. Pp. 71+18 plates. (London: Faber and Faber, Ltd., 1945.) 6*s*. net.

IN this book the general results of investigations carried out over sixty years by a great number of workers is brought together and presented in a form that should appeal to the layman. It concerns the structure and nutritional relationships between the green and the non-green plant when the connexion is not one of host and parasite but a delicately balanced relationship in which each partner has a share.

The first chapters give an outline of the physiological processes of green and non-green plants and form a useful introduction to the more complex relationships discussed later in the book. This leads on to a consideration of soil problems and the part played by the micro-fauna and flora in the breaking down of humus.

After this introduction, the author gives a description of the toadstools of woodlands with the structural features of their mycelia and the part they play in the soil and in the higher plants.

The later chapters give an interesting account of the fungus roots of coniferous and some other trees and discuss the different types of mycorrhiza and their reciprocal relations with higher plants. The researches of the author have contributed much to our knowledge of some of these problems; but many of the complex relationships are still unknown and occur not only in plants living in soils rich in humus but also in plants living in the desert where humus is almost absent. Dr. Rayner has given an outline of the technique necessary in these investigations but has confined her descriptions mainly to the macroscopic features, and this part of the book contains some excellent photographs from her own and some other sources.

The book gives a well-balanced description of the problem as it stands to-day in regard to conifers, and has provided a new meaning for the layman of the striking display of toadstools in our woodlands during the autumn months.