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Unifying Biology: Evolutionary and Molecular Biology: Science Perspectives on Divine Action

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selected but are fortuitous benefits resulting from constraint (pp. 190-197). Blurring the boundary between selected effects and fortuitous benefits, Godfrey-Smith argues, allows Kitcher to construct a false unity.

Questions of function, and especially the contrast between the Cummins-style analysis and the etiological, get at real problems, not only in biology, but also in engineering, economics, or the production of artifacts. The problem of function elicits questions about teleology as well as the relation between the biological and the non-biological. Although one might be tempted, to emphasize the way in which Cummins-style functional ascriptions apply to non-biological phenomena is to miss an interesting tension within the biological sciences. Different branches or manifestations of the biological sciences (e.g. molecular biology, physiology, ecology, phylogenetics) might prefer either the Cummins' or the etiological theories, which perhaps points to a different role in these fields of knowledge of cause.

One small thing that detracts from Buller's stated goal is the fact that the page numbers in the volume are not uniformly updated in this reprinting of the articles. One cannot count on a citation of a page number to refer to the volume in hand, which diminishes the ease with which the reader can see the debate unfold. Even so, Buller succeeds in giving even the novice a sense of the recent evolution of the debate in the function literature as well as the broader questions on which the function literature rests.

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ROBERT J. RUSSELL, WILLIAM R. STOEGER, S.J. and FRANCISCO J. AYALA (eds), *Evolutionary and Molecular Biology: Scientific Perspectives on Divine Action*, Vatican City State: Vatican Observatory Publications, 1998, xxxiv + 551 pp., \$24.95.

In *Evolutionary and Molecular Biology*, Francisco Ayala concludes his essay on evolution and design by appealing to Picasso's famous painting of the devastating bombing of Guernica during the Spanish Civil War. This painting could be described in terms of the size and position of its images, the pigments and their chemical composition. Such a description would not be fully satisfying because it would fail to capture the aesthetic value and cultural meaning of the painting. In the natural world, as in art, Ayala argues, scientific understanding is limited and does not bear on questions of value or meaning. As clear as this boundary seems for Ayala, it is not so for his companions in this volume who reveal a myriad of strategies for negotiating the boundaries of science and nature, on the one hand, and religion and culture, on the other.

Based on an international conference sponsored by the Vatican Observatory and the Center for Theology and the Natural Sciences in Berkeley, the essays in this volume explore the limits and interconnections of Christian theology and contemporary evolutionary and molecular biology. Because this project was initiated by Pope John Paul II, the resulting anthology begins with a set of messages from the Pope and a response from George Coyne, Director of the Vatican Observatory. While the project concerns both science and theology, this volume's emphasis is more on theology than science. The scientific status of evolutionary and molecular biology are reviewed in a

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series of three essays before giving way to the remaining eighteen essays concerning
theologically based problems ranging from teleology to theodicy.

Like Ayala, many of this volume's contributors are ultimately concerned with the
contemporary conflict between biology and Christianity, although their diagnoses of the
nature of this conflict and its possible resolutions are offered in detailed discussions of
a variety of theological positions. Ian Barbour provides a useful overview of both the
theological and philosophical terrain in his essay, 'Five Models of God and Evolution'.
Barbour contrasts his own process theology with four other models which emphasize
God as a top-down cause, God as a communicator of information, God as a determiner
of quantum indeterminacies, and God as the designer of self-organizing processes. As
Barbour notes, each of these models seeks to explain divine action in the world without
any violation of natural laws. Detailed expositions of variations on these models are
presented by other contributors, such as in Paul Davies's essay on teleology and
emergent complexity, Charles Birch's essay on self-organization, or Robert Russell's essay
interpreting indeterminacy in genetic mutations.

The boundary between science and religion is drawn more sharply by George Ellis when
he argues that certain outspoken advocates of evolutionary biology, such as Richard
Dawkins, Daniel Dennett and Stephen Jay Gould, have overstepped the limits of science.
These scientifically based world-views or 'scientific religions' as Ellis calls them, are meant
to rival religious world-views, but, according to Ellis, where religious thinkers have become
increasingly open-minded, science-advocates have become increasingly dogmatic. The ability
of popularizers, such to Dawkins, to fuel a highly polarized debate concerning biology and
religion is evidenced by their frequent mention throughout this volume. However, in so far
as Dawkins, Gould, Dennett, and others are discussing the extension of evolutionary
explanations to human culture, their work is particularly relevant. The final suite of essays
on relationships between biology and the foundations of ethics, in addition to Philip
Hefner's essay on biocultural evolution, demonstrate the depth of the conflict generated
when both theology and evolution are brought to bear on issues of mortality and ethics.

For readers tired of discussions of Christianity and religion dominated by scientific
creationism, the essays in *Evolutionary and Molecular Biology* provide both welcome
relief and an intellectually stimulating challenge.

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LINDLEY DARDEN, *Theory Changes in Science: Strategies from Mendelian Genetics*, New
York and Oxford: Oxford University Press, 1991, XII + 314 pp., illus., no price stated.

This book is well-organized, although a little repetitive and unequal as regards
quality. Chapters 3 to 14 are concerned with Mendelian genetics analysed in the light of
the author's concepts, while chapters 2 and 15 are the true general ones in which her
scope and original contributions are presented.

The classical case study which is examined has been frequently analysed from the
interior, without considering the cultural and social contexts, but also without even a
glimpse of the surrounding biology. As a matter of fact, its domain has been usually
identified with genetics *tout court*, although it does not apply to genetics of viruses,
bacteria, asexual or multisexual eukaryotes, but indeed its extension to these life forms