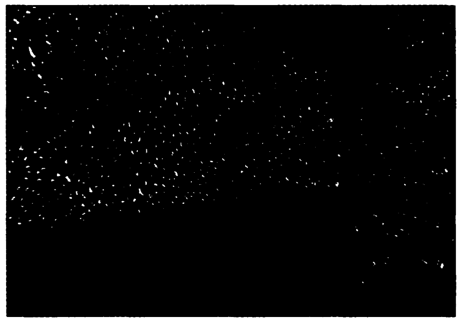
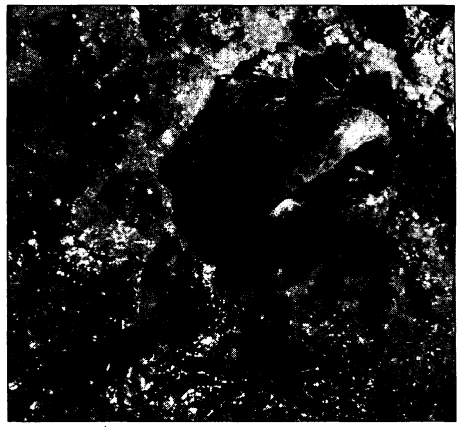
BOOK REVIEWS



"Overhead view of *Dormitator* aggregated at a dam," Panama, 1972, "apparently driven out of their backwater habitats in response to heavy use of insecticide sprays. Each fish is positively buoyant and its aerial-respiratory frontal skin patch is exposed to air." [From *Air-Breathing Fishes*]



"*Synbranchus marmoratus* at the surface of a mud burrow." [From *Air-Breathing Fishes*; L. Ford, Scripps Institution of Oceanography]

A Developmental Question

Genomic Potential of Differentiated Cells. MARIE A. DI BERARDINO. Columbia University Press, New York, 1997. xvi, 386 pp., illus., + plates. $65 or £52. ISBN 0-231-06986-3.

This book is both a monograph on the author's major research focus, the genomic potential of differentiated cells in amphibians, and a memoir of her work and associations with those investigators who have addressed the problem over the past 50 or so years. In a brief historical review, she recaptures the excitement surrounding the early amphibian nuclear transplantation experiments by Briggs and King that set the course for much of her subsequent career. Although blastula cell nuclei of the frog *Rana*, when transplanted into activated enucleated eggs, promote normal development, those taken at later stages, with more frankly differentiated cells, show a progressive decline in the number of totipotent nuclei. The author holds that this restriction is a result of differentiation and that those few cells whose nuclei do support normal development are probably stem cells whose differentiation is incomplete. Others, notably John Gurdon, emphasize the positive results, postulating that nuclei remain totipotent throughout differentiation.

An extensive treatment of subsequent work follows that amply repays close reading. The developmental potentials of nuclei from many differentiated amphibian cells are detailed, along with the various means by which this potential may be enhanced. Tissue culture prior to transplantation, serial transplantation, low temperature, chemical protection of the DNA, and viral transformation are all to a greater or lesser extent effective in improving the normal development of nuclear transplant recipients. This demonstrates that the differentiated nuclei are multipotential but does not prove totipotence. Nuclear potential in other vertebrates and invertebrates is reviewed through 1996 without altering this conclusion. Differentiation-associated genetic loss and other structural alterations are reviewed, as are reversible genomic alterations such as imprinting. The work of each laboratory, whether it accords or not with the author's views, is fairly presented and thoughtfully analyzed. The format of the book has allowed her to inject her own interpretations, which are insightful and thought-provoking.

Two major results present problems with respect to the major thesis of the book. First, the recent finding of Wilmut *et al.* that adult sheep nuclei can promote complete and normal development in a nuclear transplant recipient demonstrates totipotence. The author argues that the singular Dolly results from a stem cell nucleus, but this begs the question of what is the state of differentiation of a stem cell. Second, the ability of differentiated plant cells to reconstitute fully functional and fertile plants shows that differentiation is not necessarily accompanied by irreversible loss of genomic potential. Although this may be related to the absence of a separate germ line in plants, it is difficult to identify a plausible evolutionary reason for or against maintenance of totipotence of differentiated nuclei. Fuller understanding of the molecular mechanisms of normal differentiation may ultimately answer the question whether there is an essential block to totipotence in differentiated cells. Meanwhile, the improving ability to tease increasingly complete developmental programs from differentiated cells or nuclei bodes well for those interested in regeneration of lost physiological functions and structures in humans. This volume, by drawing together the diverse literature, provides an essential guide to the possibilities and pitfalls in such procedures.

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Aquatic Nonconformists

Air-Breathing Fishes. Evolution, Diversity, and Adaptation. JEFFREY B. GRAHAM. Academic Press, San Diego, 1997. xii, 299 pp., illus. $79.95 or £55. ISBN 0-12-294860-2.

Long before they were provided with a theoretical framework for the role of natural selection in evolution, biologists were struggling to explain the existence and significance of air-breathing fishes. How could some forms of fishes not only come to the water's surface to breathe air but, in the case of some species, actually venture onto land to forage, escape predation, or even migrate? Could these amphibious curiosities be stepping stones in the movement of life out of the oceans onto land? The early notion that extant air-breathing fishes—and especially the lobe-finned lung fishes—were some sort of missing link between typical aquatic fish and truly amphibious vertebrates was dispelled as a greater understanding of vertebrate phylogeny developed from the fossil record and systematic study of extant fishes. Even so, air-breathing fishes have continued to captivate morphologists, physiologists, and ecologists. Because air-breathing has arisen independently dozens of times in fishes, and because there are nearly 400 species of air-breathing fishes, the richness and diversity collectively presented by these animals can provide considerable insight for present-day biologists seeking to understand the selection pressures contributing to the evolution of terrestriality.