

stop the costs one must stop the growth. To some this may seem to be the classic case of throwing out the baby with the bathwater. However, there are an increasing number of vocal people who subscribe to the no-growth position. In fact, at the University of California at Santa Barbara a group has emerged which calls itself "the zero GNP growth society". The ecologists and environmentalists tend to be the most militant on this issue. One ecologist contends that "growth for growth's sake is the ideology of the cancer cell". One can easily understand the logic of those who take the no-growth position and it is probably not surprising that the reaction has been so harsh; after all for many years economic growth has been treated as an end in itself. Somewhere along the way economists forgot that increased GNP is a *means*. The ends, presumably are very complex and are intimately related to social goals; however it is not incorrect to note that one widely desired end is a higher quality of life. And to the extent that unplanned GNP growth is having a negative effect on the quality of life, it is clear that the growth dissenters have a valid point. It is also clear that "quality of life" must be defined in a rigorous fashion. It is likely that quality of life can be described by a set of social indicators which in turn can be maximized.

What is our next step? Mishan seems to despair of solving the problem. The ethic of growth is so much a part of our society that it seems improbable that it can ever be halted by a frontal attack. Almost every business or business-related institution has planned for growth and is specifically geared to achieving target growth rates. For all these expectations to be fulfilled, the total GNP must be growing as well.

In this context Mishan's recommendations are sound. The best we can offer our populace are options. Places where they can go so as not to be violated by the external costs of a "prosperous" society. Quiet areas free of jet airplanes. Rivers designated to be kept in a non-polluted state. Quiet areas on beaches and parks where the ubiquitous transistor is banned. People should be allowed to have separate facilities. Those who wish auto-free areas, cities or even regions should be given this choice. Those who want to live in automobile areas, noise zones, etc., would also have the freedom to choose.

It is likely that the simple-minded notion of maximizing GNP growth as an end in itself is no longer tenable. One hopes, however, that

society's productive machine is not merely stopped. In this reviewer's view a more desirable outcome would be to concentrate in the production of goods and services which are widely agreed to raise the quality of life. To make this goal more operational it is important that work proceed on a set of widely accepted social indicators. The social indicators can be constructed over a broad range and can even include technologically oriented indicators. For example, it is possible that air and water purity standards or noise level standards can be established. The attainment of these standards can be one of the goals or social indicators. Others would include decreased infant mortality, hospital beds per capita, leisure, city parks per capita, declining commuting time to and from place of employment, etc.

The key point is that by concentrating on the fulfillment of social indicators, the configuration of GNP will change as a natural outcome. The relatively faster growing component of GNP will include anti-pollution devices, environmental protection aids, more emphasis on esthetics. Since GNP growth as an end in itself will have been stopped, it will be irrelevant whether GNP grows, stays constant, or drops. The relevant indicators to be increased will then become the social indicators.

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Olfaction in Fishes

By Herman Kleerekoper. Indiana University Press, Bloomington and London. 222 pp., 24 pl., 86 text-figures.

Man, being primarily a visual animal, has tended to ignore and neglect study of the sense of smell. But, in spite of this, the study is a fascinating one. Kleerekoper's book reveals many of the latest findings concerning this apparently simple yet highly sensitive organ.

The book is divided into two large chapters, the first one on morphology and function of the organ, and the second on olfaction and behavior. Development, histology, anatomy, physiology, sensitiv-

ity, and theories on function are treated in the first chapter. Although organs of representative taxa are described, the comparative approach is little used, the phylogenetic approach not at all (in fact the dipnoans are out of phylogenetic sequence, placed before cyclostomes and selachians). The data on fishes, which are sometimes scanty, are placed against a background of observations from other vertebrates. This helps give a fuller picture and points out areas needing study.

One learns that the odorant, in water, moves passively into the olfactory chamber impelled by swimming movements, or actively through a pumping process activated by respiration or by ciliary action (p. 59-71). But elsewhere (p. 32) it is reported that ciliary movements were uncoordinated and did not result in unidirectional flow of fluid. Once in the olfactory sac the odorant comes in contact with the olfactory membrane whose convolutions usually form an olfactory rosette. Two cell types, receptor and supporting, are found in this epithelium. The receptors are simply nerve cells whose dendrites point outwards, whose axons join the brain directly, and hence are the most primitive of sensory receptors. The cilia of the receptor cells, which make whip-like movements, may be the site of contact with the odorant. The supporting cells phagocytize disintegrated receptor cells and may secrete mucus. Sensitivity varies but the threshold may be as low as one molecule in the nasal chamber. *Phoxinus* can be trained to distinguish between the odours of 14 species of fish. The olfactory organ clearly has an enormous potential in fishes.

The second chapter deals with olfaction as related to feeding, social behavior, defense (= avoidance of predators), parental behavior, homing, and orientation. Some interesting facets of predator-prey interactions are revealed. Prey may be warned of the presence of predators by detecting odorants emitted by the predator itself (*Gambusia* detects 'esocin' released by *Esox*) or by detecting a fright substance released from the skin of the prey species (of orders Cypriniformes and Gonorhynchiformes) when injured by predators. Predators, as shown by Kleerekoper's own work, may detect prey by their release of "Amine F." An appendix describes Kleerekoper's apparatus and methods for observing and recording locomotor patterns in fishes.

This book is a scholarly work written with considerable care. Numerous references are cited and over 600 appear in the bibliography. Rarely are important references omitted, but

Millot and Anthony's (1965) work on the coelacanth, *Anatomie de Latimeria chalumnae*, Tome II, and N. B. Marshall's (1967) study *The olfactory organ of bathypelagic fishes*, Symposium Zoological Society of London 19: 57-70, might be noted. W. Pfeiffer's (1969) important paper in *Zeitschrift für Vergleichende Physiologie* 56(4): 380-396, on the fright reaction in Gonorhynchiformes apparently appeared too late for inclusion. The illustrations, which include figures of wax models, electroencephalograms, and electron micrographs, are numerous and excellent. Although phylogeny and evolutionary adaptation are given little consideration, anatomy, physiology, and behavior are treated in considerable detail. The book is user oriented with matte paper, a bibliography, and indices to authors, species and subjects.

Olfaction in fishes is a valuable contribution to ichthyology and a reference that most ichthyologists should have on their shelves. It is regrettable that the author, formerly of McMaster University, Ontario is now at Texas A & M University, an example of that less talked about aspect of the brain drain, that of quality.

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Germination and Establishment of Weeds for Experimental Purposes

By Robert N. Anderson. The Weed Science Society of America, 2025 Burlison Drive, Urbana, Illinois, 61801, 1968, x + 236 pp., \$5.00 (US).

On first glance, you may be greatly amused by the title of this book. However, weed scientists will tell you ruefully that many weeds (and other kinds of plants) cannot be grown where and when they are wanted. In an attempt to remedy this situation, the author has summarized information on the propagation of more than 900 species which are arranged alphabetically according to their Latin names. Most of this information deals with seed germination, but comments on vegetative reproduction are presented where applicable.

Anderson has assumed a very wide interpretation of the word "weed, consequently his book will prove valuable to many people who are not weed scientists. In addition to plants that grow in arable land, he presents information on woodland herbs,



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