and mixing it with fuel in a combustion chamber. The exhaust from the continuous explosion in the combustion chamber drives turbine blades, which power the spinning blades at the front to suck in more air.

In modern turbofan jet engines, much of the air sucked in at the front "bypasses" the combustion chamber and is forced out the back of the engine, pushing the plane along much as the air coming off a propeller would. If this air had to pass through the combustion chamber, as it did in early jet engines, all that extra air would have to be combined with enough fuel to make it combust. This wastes a great deal of fuel without giving the plane much extra push.

Jet airliners now use "high bypass" engines that force one part of air through the combustion chamber for every six parts pushed straight out the back. As engineers designed jet engines with higher and higher bypass ratios, the question became: Why not make an engine where almost all the air bypasses not just the combustion chamber but the engine itself?

Thus was invented the propfan, an "ultra-high" bypass engine that is a throwback in two ways. The fan blades are on the outside of the engine like a propeller, and all the air that passes inside the engine goes through the combustion chamber as in the earliest jets.

The result, though, is anything but a throwback. With 20 to 40 times as much air bypassing the combustion chamber as goes through it, the engine becomes very fuel efficient. The propfan engine offers about a 40 percent increase in efficiency over engines now on airliners, according to Don Hanson, a spokesman for the Long Beach, Calif.-based aircraft division of McDonnell Douglas Corp.

Many new turbofan engine designs just coming into production also use very high bypass ratios for increased fuel efficiency, but the propfan is still about 25 percent more efficient than these, Hanson says.

Yet fuel efficiency may not be enough. With the price of fuel low and no sign it will rise anytime soon, aviation fuel costs rate low in the priorities of many airlines at the moment, according to industry sources.

"Fuel is not a major concern for airlines right now," says Jack Gamble, a spokesman for the civil aviation division of the Boeing Co. in Renton, Wash. "The executive of an airline will be looking at the cost of labor, the cost of [loans], the cost of ground operations. After all that, the cost of fuel becomes rather insignificant."

New technologies must prove themselves, must "earn themselves onto an airplane," Gamble says. Others cite the time-consuming testing and Federal Aviation Administration (FAA) clearances for devices such as LEBUs and HLFC when explaining why fuel-efficient devices may not reach airplanes for many years.

Nevertheless, McDonnell Douglas is pushing ahead with the propfan engine. In September the company flew an MD-80 jetliner with a General Electric propfan engine at the famous Farnborough Air Show in England, and McDonnell Douglas plans to begin making propfan-powered planes in the early 1990s. Riblets, being a simple technology, should begin showing up on airplanes in the next two or three years, NASA's Anders says. And the military's need for long-distance flight without refueling will keep that sector interested in drag-reduction technologies, HLFC researcher Wagner says.

Then again, depending on the occult dynamics of OPEC and the vagaries of oil exploration, fuel prices may skyrocket once more. If they do, the campaign to scrimp on precious petrol will begin again. Airlines will demand fuel-efficient planes from manufacturers, the FAA will push through approval on fuel-efficient designs and more money will be spent on research. In the end, of course, money and economics are what determines whether fuel-efficient designs take off or languish. □

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The Ages of Gaia: A Biography of Our Living Earth — James Lovelock. This book expands on the theory of Gaia — the Earth as a single living organism with all living species as components of that organism. The author first sketched the theory in 1979, and here he explains the ages of Gaia: the Archean, when the only life was bacteria; Middle Age, when many-celled plants and animals emerged; and Modern Times. Closing chapters explore the possibility of establishing a geophysical system on Mars and the meaning of Gaia in the context of religious faith. Norton, 1988, 252 p., illus., $16.95.

Annual Reviews of Phytopathology, Vol. 26 — R. James Cook, Ed. Includes reviews in the fields of abiotic stress and disease, molecular genetics and breeding for resistance. Annual Reviews, 1988, 493 p., charts & graphs, $36.00.

Creation: The Story of the Origin and Evolution of the Universe — Barry Parker. This physicist and award-winning science writer traces the universe from the Big Bang and its initial dramatic expansion to the first nuclei and atoms and the formation of galaxies and their distribution in space. The text goes on to explain how elements formed in stars and life emerged in the universe. Woven throughout the book is an interesting look at the scientists who made these discoveries. A glossary of technical terms is included. Plenum Pubs 1988, 297 p., illus., $22.95.

Kourion: The Search for a Lost Roman City — David Soren and Jamie James. Archaeologist Soren and journalist James here chronicle the excavation and reconstruction of this ancient Roman city on the southern coast of Cyprus, which was destroyed by a great earthquake in A.D. 365. Details Soren's discovery of the world's earliest preserved Christian community. Doubleday, 1988, 222 p., color/b&w illus., $21.95.

The Mind — Richard M. Restak. Provides the general reader with a beautifully illustrated overview of the thinking of many varied authorities on the nature of the mind. As a companion guide to a nine-part PBS television series "The Mind," it focuses on nine aspects of the mind: philosophy, development, aging, addiction, pain and healing, depression and mood, thinking, language and violence. Bantam, 1988, 328 p., color/b&w illus., $29.95.

The New Dinosaurs: An Alternative Evolution — Dougal Dixon, foreword by Desmond Morris. The author, by mixing geologic and paleontologic fact with fantasy, creates a unique vision of how dinosaurs would look and act today if they had not become extinct. Stunning color illustrations introduce fantastic animals, such as the glub of the woodland swamp, the nectar-sucking gimp of the Neotropical realm and a flock of whiffles in the Palaearctic tundra. Discusses current extinction theories and the fundamentals of dinosaur evolution and classification. Salem Hse, 1988, 120 p., color/b&w illus., $19.95.

Roadside Geology of Alaska — Cathy Connor and Daniel O'Haire. Following the main highways and roads of Alaska, this book explores the varied geological formations of the landscape, from Devil's Desk to Snowslide Gulch. Maps and photographs enhance the text in this roadside reference. Mountain Pr, 1988, 250 p., illus., paper, $12.95.

Seasons of the Seal — Fred Bruemmer and Brian Davies. Follows the life of one harp seal as she mates, migrates and gives birth to her pup in subzero cold. More than 135 spectacular photographs dominate this story, which includes some natural history of the harp seal and describes how the Inuit people have depended on the seal for survival. Northword, 1988, 159 p., color illus., $29.95.

Worse Than the Disease: Pitfalls of Medical Progress — Diana B. Dutton. Explores the social, ethical and economic dilemmas modern society faces as a result of medical innovation. The author presents for the general reader case studies of innovation with adverse side effects — DES, the artificial heart and the swine flu immunization program. She also discusses the possible future problems of unmonitored genetic engineering research. Concluding chapters are devoted to the policy issues arising from the cases, such as risks and rights of participants in medical studies, compensation for injury caused by medical innovation and the role of the public in forming future public health policy. Cambridge Univ. Press, 1988, 528 p., $29.95.