non shows that WT 15000's thoracic neural canal (from T3 to T11) is not as expanded as in modern humans. She rejects the earlier suggestion that this would reduce muscular control to the upper extremities, arguing instead that this condition implies reduced innervation of the mid or lower trunk. This is likely to be associated either with decreased muscular movement or control of the trunk or with decreased control of breathing. Walker combines this "decreased control of breathing" interpretation with the fact that the cerebral assymetries and presence of Broca's cap on the endocast do not necessarily demonstrate language ability to argue that *H. erectus* did not possess fully developed human language and speech.

As Walker aptly states in his summary discussion of the specimen, WT 15000 "has changed the narrative of our own evolution and illuminated yet other areas of our ignorance" (p. 411). The information provided by the various studies reported in this volume is of immense value to our knowledge of human evolutionary history. The authors and editors have provided a model for descriptive and comparative analyses against which all subsequent endeavors will be measured. In my opinion, this work will stand as one of the classics of paleoanthropology.

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An Energy Alternative

Renewable Energy from the Ocean. A Guide to OTEC. WILLIAM H. AVERY and CHIH WU. Oxford University Press, New York, 1994. xxx, 446 pp., illus. $65. Johns Hopkins University Applied Physics Laboratory Series in Science and Engineering.

An enormous renewable energy resource exists in the tropical oceans. The authors of this book state that this resource could be exploited to produce a large fraction of the world's energy needs in the form of methanol or ammonia and that any associated deleterious environmental effects would be minimal.

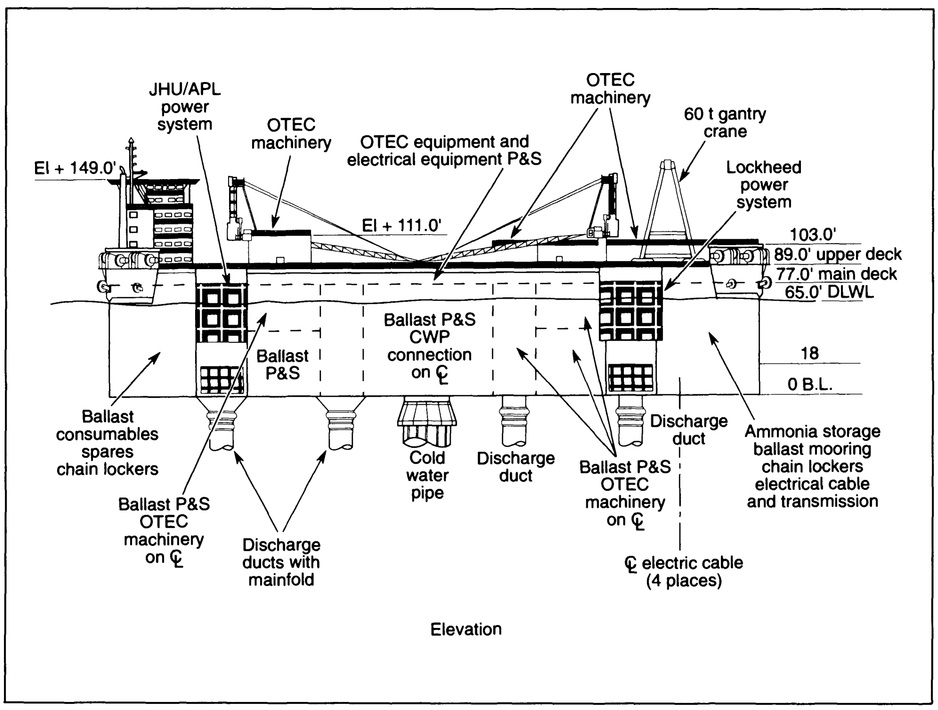
The sunlight that falls on the oceans is strongly absorbed in the upper 100 meters, raising the temperature of a top layer of tropical oceans to about 28°C. This temperature is nearly constant day and night and month to month. In contrast, most of the deep portions of the oceans are at temperatures of 4°C or less. Scientists and engineers have long been aware of methods of exploiting the temperature difference. As a result of the energy crisis of the 1970s, the United States invested $260 million for research and development of Ocean Thermal Energy Conversion (OTEC). Other nations, including France and Japan, were similarly active. Engineers from U.S. national laboratories and high-tech companies carefully considered the many detailed aspects of design of practical long-term seagoing plants. Sufficient progress was achieved that in 1980 Public Law 96-310, establishing goals that included the creation of 500 megawatts of OTEC electrical energy or energy products' equivalent by 1989, was enacted.

In September 1980, the Department of Energy issued a Program Opportunity Notice (PON) inviting industry to participate in a program to produce a 40-MWe OTEC pilot plant. The PON stated that the department would fund five to eight contracts at $900,000 each for the first phase of a six-step program leading to a successful venture. Industrial response was enthusiastic. Eight proposals were received. After the 1980 election, however, the federal support fizzled out.

One of the key participants in OTEC studies was William H. Avery. His participation and that of his employer, the Johns Hopkins Applied Physics Laboratory, began in the early 1970s. Since then, Avery has been steadfast in his commitment to OTEC. He has taken part in many national and international meetings concerning it and has created and maintained a database that includes 2500 items, most of which are detailed technical articles. Together with Chin Wu of the U.S. Naval Academy, he has prepared a heavily referenced book that will be invaluable to those who will later seek to exploit OTEC on a large scale.

The book treats in detail solutions to the many problems that must be dealt with to create successful large-scale 200- to 400-MWe OTEC plants. For example, it was determined that seagoing vessels housing the plant should be constructed of reinforced concrete and in one design should be 275 meters long, 119 meters wide, and 27.4 meters in the vertical dimension. Concrete would be used because it is cheaper than steel and not subject to corrosion. The plants would be designed for a long life and for resistance to hurricane conditions. One of the many other considerations included provisions to supply about 500 tonnes per second of cold water drawn from 1000 meters below the surface.

In the conversion of thermal to electrical energy, a working fluid (ammonia) in a boiler would be heated by the warm water, creating a vapor pressure of about 9 atmospheres. The vapor would drive a turbogenerator to produce electrical energy. The ammonia vapor would be cooled and condensed on surfaces chilled by the cold water and then recycled. The electrical energy would be used to electrolyze water to hydrogen and oxygen. The hydrogen would be reacted with nitrogen from air were ammonia the desired product. Ammonia could be used as a motor fuel if greenhouse problems



"Subsystems layout of baseline 40-MWe OTEC barge." [From *Renewable Energy from the Ocean*; George and Richards, 1980]

Vignettes: Papers in Press

Since the goal of most researchers is publication, not lecturing, most scientific conferences are rehashes of old work punctuated by tantalizing previews of forthcoming articles. Those with nothing new to say speak too much; those with real news, too little.

—*Barry Werth*, in *The Billion-Dollar Molecule: One Company's Quest for the Perfect Drug* (Simon and Schuster)

Not long ago, I met a physicist who told me that he had never had a manuscript rejected by a journal editor. He was proud of this, but I found his statement troubling and was not sure why. Perhaps it was envy, because I have had my share of rejections? The more I thought about it, the clearer the answer became: He had not been reaching far enough.

—*Robert J. Weber*, in *Forks, Phonographs, and Hot Air Balloons: A Field Guide to Inventive Thinking* (Oxford University Press)

became paramount. Economics and demand make methanol (CH_3OH) the current product of choice. The necessary carbon would be furnished by shipments of coal. This would be converted mainly to CO with the oxygen produced by electrolysis and steam. The CO would then be reacted with hydrogen to form methanol. A large-scale floating plant would produce 1750 tonnes per day that would be stored and later transferred to a tanker about once a month.

Careful analyses of potential problems, detailed designs of OTEC plant ships, and consideration of costs occupy most of the book. Part of it is devoted to some limited practical experience. The state of Hawaii has supported small-scale OTEC plants based on land, but near deep water. By-product nutrient-rich cold water is valuable for mariculture and for cooling. Private enterprise assembled and operated near Hawaii a small seagoing OTEC plant that was technically successful but not financially viable.

The costs of oil and natural gas are currently such as to discourage commercial construction of large-scale OTEC plants. However, U.S. production of oil continues to decrease and imports climb. In view of many long-term uncertainties about energy consumption and supplies such as effectiveness of conservation measures, ability to pay for imports of liquid fuels, and greenhouse warming, this nation should be more vigorous in developing alternative energy sources.

With the knowledge set forth in *Renewable Energy from the Ocean* and its bibliography, a 40-MWe seagoing pilot plant could be constructed. Cost would be about $200 million in 1990 dollars. Construction could be relatively rapid, since most of the components would be commercially available. The authors provide extensive evidence that with experience costs of OTEC would be substantially reduced and that ultimately production of methanol and ammonia by OTEC could be made cost-competitive.

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Language and Its Disorders

Understanding Aphasia. HAROLD GOODGLASS. Academic Press, San Diego, CA, 1993. xii, 297 pp., illus. $54.95 or £42. Foundations of Neuropsychology.

Aphasia is the loss or disruption of language abilities following a focal brain injury. The most common cause of aphasia is stroke, which has some effect on language faculties about 20 percent of the time. Aphasia is a significant public health problem: it is estimated that more than a million Americans have some form of aphasia, with frequently devastating consequences for employability, independence, and quality of life.

But aphasia is much more than a medical issue. For more than a century, the study of aphasia offered the only means available for addressing the question of how language is represented in the brain. Until the very recent development of technology for functional brain imaging, theories about language-brain relationships were based entirely on studies correlating damage in particular brain regions with specific aphasic symptoms. The single fact about aphasia that allowed its study to play this role, and the fact that continues to make it interesting today, is that its effects on the language system are varied and often quite selective. For example, patients may be able to produce words as names for objects that they are allowed to touch, but not for objects that they take in only by sight; other patients seem to lose the ability to understand words drawn from a single semantic category (animals, body parts) but to have no difficulty with words in other categories. Perhaps most paradoxically, some patients have great difficulty producing words that are the most frequent in the language—words such as "the" and "of"—while easily producing much longer and less frequent words; other patients show precisely the opposite pattern.

Understanding Aphasia is the long-awaited work of a man who has arguably done more than any living person to describe systematically the many varieties of aphasia and to bring some order and coherence to their study. For the past several decades, Harold Goodglass and his colleagues at the Boston University Aphasia Research Center have led the movement to supplement the interesting and important, but largely anecdotal, case reports of clinicians with rigorously controlled and psychometrically valid tests of patients' language abilities. This book is an appropriate testament to Goodglass's career, as it succeeds in setting out an orderly description of aphasia and its long history while making clear how difficult and confusing its study can be. It contains many well-chosen examples of the speech, writing, and other performances of individual patients the author has seen, providing an informative introduction to aphasic phenomena for those new to the topic.

There is much more of interest here, and some surprises, for specialists who are already familiar with the field of aphasia research. The author never ventures far from questions of neuroanatomy, returning repeatedly to discuss what is known about the location of the brain lesions that are associated with particular aphasic manifestations. At the same time, he reviews in some detail studies that are much less concerned with neuroanatomic correlation than with using the patterns of symptom dissociations found in aphasia to build and test cognitive models. A recurring theme is the essential similarity of the guiding neuroanatomic model of language-brain relationships and the information-processing ("box and arrows") models of normal language organization: both involve sets of discrete processing components through which information passes in serial order.