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LETTERS

Law of the Sea Negotiations

The short report on the recent Geneva session of the Law of the Sea Conference by Deborah Shapley (News and Comment, 30 May, p. 918) is deficient in describing the "Informal single negotiating text" on the law of the sea; perhaps the most serious deficiency concerns the articles on scientific research. Shapley's report misses significant elements of the relevant articles and omits mention of other, quite different, articles on the same subject. In total, the draft articles are a disaster because of their potential impact upon the conduct of research at sea, but one would not get this impression from the *Science* report. Scientists should be aware of the unsatisfactory state of these articles, since versions of some of them could well be in the treaty that eventually emerges if nothing is or can be done to change the outcome.

Part I of the negotiating text concerns the seabed and contains what should be considered wholly unacceptable articles on research. These provisions would permit seabed research, such as the Deep Sea Drilling Project, only after the sponsoring entity reaches a contractual arrangement or some other form of association with the International Seabed Authority, which would be created by the treaty. The Authority would not be required to conclude such a contract or association, and in any case the arrangements it makes must permit it to exercise direct and effective control over the research activity. Part III of the text also contains articles on seabed research, and it provides, as Shapley notes, for free conduct of research subject to notification to the Authority, but there is presently no assurance that the Part III text will be adopted.

Shapley's description of the economic zone and continental shelf articles is only partially correct. Research in the economic zone (approximately 35 percent of the ocean if a 200-mile limit is adopted) and on the continental shelf (where the margin extends beyond 200 miles) is dealt with in Parts II and III of the text, and the two parts are not entirely consistent. In Part II, Articles 49 and 71 provide that consent of the coastal state must be obtained to conduct research in the economic zone and on the shelf. This means that a substantial part of current marine research at sea would, in the future, be subject to the discretionary control of the coastal state. The text does add that, under certain conditions, such consent shall not normally be withheld, but this same proviso has proved

worthless in the existing shelf treaty, and no one takes it as a serious limitation on coastal state authority in the informal text.

Part III, which is partially described in Shapley's article, does make a distinction between resource-related and fundamental research in the economic zone, requiring coastal consent only for the former. However the distinction between the two types of research is not defined in these articles; this task is left to an unidentified forum at some unspecified future time. In practical effect, the lack of a definition leaves it to the coastal state to decide which research is resource-related, and that decision is not effectively reviewable. In essence, these articles also would establish a consent regime for research.

It seems likely that, unless vigorous action is taken by the scientific community, there will be serious obstacles to scientific research at sea in the future as a result of a Law of the Sea treaty. These obstacles will mainly result from the transfer of control over research from sponsoring groups and states to coastal states. Research certainly will not end as a result, but its pace, magnitude, and location are likely to be affected in undesirable ways because of funding and political decisions attendant upon the shift in control. It is likely, too, that scientists will choose not to conduct research in those areas where major barriers and unpalatable conditions are imposed.

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Mention of the consent requirement of Articles 49 and 71 in Part II of the negotiating text was omitted because the committee that wrote them, Committee II, has no jurisdiction over scientific research. Committee III, whose views are reflected in Part III of the text, has jurisdiction over most scientific research, and Committee I, whose views are reflected in Part I, has some jurisdiction over resource-related research in the high seas and the seabed.

—D.S.

Tetrapod Gait Patterns

In his review of P. P. Gambaryan's *How Mammals Run (I)*, Matt Cartmill (23 May, p. 844) states that asymmetrical gaits "are of particular importance for two reasons: they are the characteristic high-speed gaits of terrestrial mammals, and they are unique to the class Mammalia." Asymmetrical gaits are divided into two classes by Gambaryan, either ricochets or gallops.

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I would like to point out that crocodilians can gallop (2) and, therefore, asymmetrical gaits are not unique to mammals.

This observation should not detract from either Gambaryan's thesis on mammalian locomotion or Cartmill's critique. However, since crocodilians are survivors of a once major archosaurian radiation, this observation bears on the currently popular question of the extent to which archosaurian reptiles, particularly dinosaurs and their descendents, converge on mammals. Bakker (3) has amassed data to show that dinosaurs were active, cursorial homeotherms and apparently believes certain quadrupedal forms galloped (4). Gambaryan derives bipedal mammals from ancestors with high-speed, asymmetrical gaits. Certain recent reconstructions of ornithischian dinosaurs present generalized forms as fast-moving, highly active bipeds (5); the once-accepted image of dinosaurs as slow, lumbering beasts is fast fading. Furthermore, both Bakker and Ostrom (6) derive birds directly from saurischian dinosaurs and Ostrom conceives of *Archaeopteryx* as a "very active, fleet-footed, bipedal, cursorial predator." Vestiges of asymmetrical gaits not only occur in crocodilians, but can be seen in modern birds during take-off.

If asymmetrical gaits have been important in the evolution of the Mammalia, they must also have been important in the evolution of the Archosauria.

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"Ecology": A Clarification

It is quite true that the history of ecology is largely unstudied, but R. Goodland (Letters, 25 Apr., p. 313) does not clarify the history of ecology with his assertion that Henry David Thoreau, rather than the zoologist E. H. Haeckel, first used the word "ecology." This misunderstanding was explored some years ago in the pages

of *Science*. Walter Harding, a well-known Thoreau scholar, had transcribed (1) a handwritten letter from Thoreau to his cousin Henry Thatcher, which is the source of the quotation—including the word "ecology"—to which Goodland alludes. P. H. Oehser (2) followed Harding in ascribing the word "ecology" to Thoreau. Subsequently, Harding reviewed his transcription of the Thoreau letter and stated (3) that the word he had earlier read as "ecology" was actually "geology."

The science of ecology had very diffuse origins in botany, zoology, oceanography, limnology, and various aspects of natural history and applied biology, and it is impossible to attribute its founding to one individual. Ecologists do not generally assert that Haeckel was the founder of ecology. There is, however, general agreement that he coined the term "oecology," recognizing it as a logical subdivision of biology, that he provided a reasonably usable definition, and that he first used the word in 1866 or 1869.

It is clearly the case, as Goodland states, that ecology as a formal, named aspect of biological science owes much to J. E. B. Warming and also to other European botanists: O. Drude and A. F. W. Schimper published extensive studies on "Oecology" in the 1890's and stimulated interest in ecology in the United States, especially on the part of C. E. Bessey and J. M. Coulter and their respective students F. E. Clements and H. C. Cowles. The pages of *Science* (4) provide a detailed exchange of letters concerning the origin, etymology, meaning, and proper spelling of oecology or ecology.

Depriving Henry Thoreau of whatever honor there may be in being the earliest user or coiner of the word ecology does not deprive him of the very proper recognition of his role as a pioneer ecologist (probably before the word existed) who clearly recognized the ecological concept of succession (5) and who is commonly described as the father of phenology (6), an important facet of ecology dealing with the chronology of natural events.

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