costs are at the heart of the publication problem, which can be divided into seven elements: (i) generation of original material; (ii) motivation for (i); (iii) evaluation of written material; (iv) editing of written material; (v) motivation for (iii) and (iv); (vi) production of user's hard copy; and (vii) distribution.

The book system takes care of (ii) with royalties to the author, and of (v) with reimbursement and profits to the publisher. In xerography, (vi) and (vii) are partially interchanged in time, using a few publisher-distributed hard copies to generate many locally printed copies, evading the internalization of costs (ii) and (v).

Even without royalties, authors will generate new material: witness scientific papers. But publishers cannot publish at a loss forever. Xerography is a parasitic technology: it needs something to copy. If books disappear we will presumably be left with typewritten copy which can be fed into computer networks. If elements (iii) and (iv) are lacking we will surely be swamped with more trash.

If, on the contrary, the evaluation and editing now carried out by publishers are transferred to juries of peers, supported by the government, will the result be better or worse? Anyone who looks with equanimity to the imminent destruction of the host (conventional printing) by the parasite (xerography) should justify such meliorism.

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Oil Spills and Offshore Drilling

The article by William B. Travers and Percy C. Luney "Drilling, tankers, and oil spills on the Atlantic outer continental shelf" (19 Nov. 1976, p. 791) is directed at a timely problem, but the comparison it purports to make is flawed by an incomplete argument, factual errors, and a misuse of oil spill statistics taken from a report we coauthored (*1*).

We begin with the factual errors:

1) Travers and Luney state that "Since 1972 no major oil spills have occurred." Presumably the authors were unaware of the spills listed in a U.S. Geological Survey (USGS) annual report (*2*) (Table 1). There was also a large spill from the Cobia pipeline on 9 September 1974, but this incident only involved 2213 barrels, so it wouldn't fit into Travers and Luney's criterion for a "major spill" (more than 5000 barrels).

2) The authors say that before 1969 "more than 7000 wells were drilled . . . without a large oil spill occurring." Tables 1 and 5 in their article refer to four spills associated with drilling, production, and pipelines before 1969, three of which are more than 5000 barrels. St. Amant, an observer of the Gulf Coast outer continental shelf (OCS), thinks (*3*) that the worst of the Gulf spills occurred about 1961. The CATCO platform, 30 miles off Empire, Louisiana, caught fire. The fire was extinguished by dynamiting, and the well then ran crude oil for a week. A 50-square-mile slick came ashore and then blew out again, with apparently no permanent damage. Spills were not reported in those days, but this spill is well known to those who were active in offshore production at that time.

3) The authors also say that "No blowouts have occurred during drilling in the U.S. Gulf region in the past 5 years." The USGS (*2*, table A, pp. 7–11) lists 14 blowouts in the years from 1972 through 1976. One involved the complete loss of a rig. One involved heavy fire damage and three injuries. One burned for 2 days, spilling an unknown quantity of oil. Not all of these blowouts were associated with drilling (three were caused by hurricanes), but the comparison the authors purport to make between tanker imports and offshore production would appear to obviate such semantic distinctions.

In addition, there are a number of statements in the article that are logically incomplete, making review difficult. For example:

1) "Unreported spills have been significant because official offshore reports have not included tanker spills occurring in harbors or near terminals, and the Coast Guard's authority for reporting vessels extends only to the 3-mile territorial waters limit." The reference is to our report (*1*, p. 90), in which we simply said that tanker spillage was well reported in U.S. harbors and nearshore areas, but that the Coast Guard's authority for regulating oil spillage extended only to 3 miles (for foreign tankers), and so we were not sanguine regarding the completeness of the offshore ship spillage records.

2) "Offshore production and pipelines invariably introduce less crude oil and petroleum into the environment than do tankers and sources of automobile waste oil (Table 3)." A comparison like this raises the possibility of comparing every offshore activity with some "baseline" activity like sailing. Obviously we should like to know the payoff as well as the price, and so the figures of table 3 tell on-

ly half the story. Nor is "invariably" a very well-chosen adverb, since in the preceding sentence the authors say it would take only seven Santa Barbara spills in 1 year to exceed the spillage from worldwide tanker operations. (In recent years, tankers have carried about 1.3×10^9 metric tons of oil annually over an average distance of about 6500 miles.)

There are two conclusions Travers and Luney apparently would like us to draw regarding the Atlantic OCS development. First, they present arguments suggesting that the blowout problem will be minimized due both to differences in the geology of the region as compared to the West and Gulf coasts and to improved operational procedures. Implicit in their approach is the idea that blowouts are of paramount importance in the offshore spillage problem. Second, they appear to want us to conclude that (apparently irrespective of such improvements) offshore production is much preferable to the importation of crude oil, particularly when it is to be carried in foreign "flag of convenience" tankers.

The speculation regarding the possible decrease in blowouts in the Atlantic OCS is an interesting one, but such improvements are unlikely to significantly change the offshore development spillage problem. Again resorting to the USGS data (*2*, table D, pp. 1–12), we find that, of the 55 accidents in federal OCS waters from oil and gas operations that resulted in spillage of 50 barrels or more of oil, only six were associated with blowouts. Thus, eliminating this source of trouble completely would only result in a modest decrease in the incidence of oil spills. It is an important enough improvement that we should be pleased to have it, but it will hardly negate the oil spill problem. This means that the authors cannot rely upon improved blowout performance to support their conclusion "that exploration for and development of petroleum resources on the Atlantic outer continental shelf is the environmentally preferable alternative to increasing oil imports by tankers." To support this statement, they must truly show that their belief in the superiority of offshore production to tanker imports is supported by the data, irrespective of hypothesized improvements in the blowout problem.

In the authors' attempt to prove this point, they misuse statistics drawn from our report (*1*). If we discard the many non sequiturs regarding the characteristics of large tankers, and if we discount the nonquantitative and unproved allegations regarding foreign tankers, the whole of their argument rests on three numbers drawn from a postscript we inserted in our report. This postscript followed 117 pages in which we attempted to dissuade the reader from using volume spilled per volume handled as the sole parameter in characterizing spillage performance. At the time, this was argued on semi-intuitive grounds based on both the small number of spill incidents involving offshore production platforms and pipelines, and on the highly skewed nature of oil spill volume distributions.

Table 1.

Date	Type and cause of spill	Volume reported spilled (barrels)
1 January 1973	Platform structural failure	9,935
12 May 1973	Pipeline leak, due to corrosion	>5,000
17 April 1974	Break in Bonita pipeline; probable cause, anchor dragging	19,837

Table 2.

Source	1973	1974	1975
Number of spills of crude oil greater than 100 gallons			
Tankers (Portland, Maine; New York, New York; Los Angeles, and Long Beach, California)	18	10	4
Offshore production (platforms and pipelines)	208	135	84
Volume of crude oil handled (10^6 barrels)			
Tankers	361	323	375
Offshore production	583	533	495

Disregarding these warnings, Travers and Luney proceed to use our three numbers in the following way. "Tankers are the source of the *highest* volume of oil spilled (0.016 percent of the total volume of oil handled); platforms have the *lowest* volume spilled (0.006 percent)," and later, "Even in the past, however, pipeline spills were still less than those from tankers [0.011 percent as opposed to 0.016 percent . . .]" [emphasis ours]. The "highest" and "lowest" are nowhere qualified to mean highest and lowest of the *three* categories considered. Rather, the reader is left with a much more universal interpretation—one that is not supported at all by our report. Further, the platform and pipeline spillage referred to in our report was associated solely with U.S. production of crude oil offshore. Thus, the total spillage for offshore production falls in at 0.017 percent, and it is this number that should be compared to the tanker spillage figure if we wish to address the relative merits of offshore production versus tanker-borne imports and if we insist on limiting ourselves to this parameter.

Thus, Travers and Luney lead the reader to a conclusion that is not supported by the information at hand. Nor do they warn the reader of the highly uncertain nature of the parameter they have selected to characterize platform and pipeline spillage.

Lest the reader still believe that the comparison between offshore production and the importation of foreign crude oil is one wholly favorable to offshore production, we can readily compare the number of spills of crude oil associated with the tanker transport of foreign and extraregional domestic crude oil with the spillage seen in the offshore production of crude oil in U.S. waters. By selecting the appropriate ports, we can even achieve an approximate equivalency in the total volume of crude handled by the two alternatives. Table 2 shows the results of such a comparison. The spillage numbers are reliable within a factor of 2, and the volume figures should be correct (*4*). The original data source for the oil spill information was the Coast Guard Pollution Incident Reporting System (PIRS) (*5*). Only those spills over 100 gallons were considered due to regional inconsistencies within the PIRS data for spills smaller than this size.

The number of tanker spills is only good to within a factor of 2 because we have not counted those spills of fuel and lubricating oils that accompany the operation of the tankers. A detailed comparison of the State of Maine spill data with the PIRS data revealed that there is about one noncrude spill for each crude spill associated with the crude oil trade (*5*, pp. 51–52). The offshore production spill data were shown to have the same sort of uncertainty by comparing USGS data with the PIRS data. Only about half the spills recorded by the USGS found their way into the PIRS data (*5*, pp. 25–27). However, the factor of 10 differences between the number of spills for tankers and OCS production suggest that a comparison made solely on the basis of environmental considerations is liable to favor the tanker import alternative.

In the heated atmosphere surrounding the offshore leasing program, it seems inevitable that our remarks will be interpreted in an adversary situation, and probably used against the leasing program. This was not and is not our purpose. We both believe that OCS development can be carried on in an environmentally acceptable fashion. Further, the economic benefits that may accrue through an OCS leasing program are enormous. We strongly support the program for these reasons.

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1. J. W. Devanney III and R. J. Stewart, "Analysis of oil spill statistics," in *Primary, Physical Impacts of Offshore Petroleum Development* (Report No. MITSG 74-20, Massachusetts Institute of Technology, Cambridge, 1974).
2. Conservation Division, "Accidents connected with federal oil and gas operations on the outer continental shelf" (U.S. Geological Survey, Reston, Va., 1976), table E, pp. 9–11.
3. L. St. Amant, personal communication.
4. The figures for the volume of crude oil brought into the three ports are from the Army Corps of Engineers [*Waterborne Commerce of the United States* (New Orleans, La., 1973–1975), vols. 1 and 4 for each year], and the offshore production values are taken from the Conservation Division, *Outer Continental Shelf Statistics* (U.S. Geological Survey, Reston, Va., 1951–1975). An approximate conversion of 6.5 barrels per short ton was used to convert the Corps of Engineers data into barrels.
5. R. J. Stewart, *A Survey and Critical Review of U.S. Oil Spill Data Resources with Application to the Tanker/Pipeline Controversy* (Report to the U.S. Department of the Interior, Martingale, Inc., Cambridge, Mass., 1976), p. 54.

Travers and Luney have produced an interesting and useful assessment of the probability of blowouts occurring during Atlantic outer continental shelf (OCS) oil and gas exploration and development. Their analysis, however, falls far short of proving their thesis— that the geologic conditions of the Atlantic OCS make the development of its oil and gas resources "environmentally preferable" to increasing imports of oil in foreign-flag tankers. In making the social choice of whether or not to develop petroleum resources on the Atlantic OCS, and, if so, what regulations or restrictions are necessary, we are compelled to consider a broad array of socioeconomic, political, geological, and biological facts that such a choice involves. The authors' sweeping conclusion is based on only two components— blowouts and tanker performance—of this very complicated issue. Below we discuss the major points we think Travers and Luney have overlooked.

1) We agree with the authors' assessment that tankers represent a major source of oil spills. This fact has been demonstrated since the publication of their article by the grounding of the Liberian tanker *Argo Merchant* on the Nantucket Shoals, which produced the worst oil spill ever to occur in North American coastal waters. Moreover, 1976 proved to be the worst year in history for tanker mishaps (*1*). However, we cannot agree that the use of tankers will decrease as a result of oil and gas development in the North Atlantic. To the contrary, production of oil and gas from the area covered by Lease Sale 42, which includes Georges Bank, will probably result in an *increase* in tanker traffic. The estimate of oil and gas resources recoverable from that area is too low to economically justify the use of pipelines for transport of oil ashore (*2*, p. 631), making small tankers (20,000 to 30,000 dead weight tons) the most probable mode of transport. Use of these smaller and generally older tankers could result in chronic discharge of oil and more accidents. Moreover, as no refineries are located in the New England region, piping oil ashore would not eliminate the need for tanker transport of the same crude oil to refineries, presumably those in the mid-Atlantic states, and the subsequent return by tanker of refined oil to New England.

2) The offshore regions of New England have historically been and continue to be areas of intensive fishing activity. The extension of U.S. fishing jurisdiction to 200 miles offshore last year gives assurance that the nation's dependence on and stake in the protein resources of Georges Bank, one of the world's prime fishing areas, and other fishing areas will continue to be of the highest priority. A meaningful discussion of the environmental preferability of any activity in the North Atlantic must, consequently, include an assessment of the impact of anticipated activities on fisheries resources. Such a discussion is notably absent in the article by Travers and Luney; nowhere is there mention of the environmental consequences of the introduction of thousands of tons of drilling muds, drill cuttings, and formation waters into the marine environment. Moreover, the authors do not discuss the impact of

physical obstruction of fishing activities by drilling rigs, platforms, and pipelines; nor do they attempt to assess the impacts that the release of hydrocarbons from OCS activities will have on marine biota.

3) Bottom currents over Georges Bank are very strong and, as a result, sediment transport is very active. Large sand waves and ridges cover a sizable percentage of Georges Bank and the Nantucket Shoals (*3*). Some of these features have migrated up to 305 meters in a 25- to 28-year period (*4*). Smaller sand features move at a much greater rate. The migration of these sand waves and the extensive sediment transport that occurs in general represent significant geologic hazards that the authors do not mention. Sediment erosion and transport could result in partial or complete removal of sediment cover emplaced to protect pipelines (if used) from anchor dragging and impacts resulting from fishing activity. While pipelines have a low casualty rate, when they rupture a disproportionately large volume of oil is spilled. Between 1967 and 1975, 202,199 barrels of oil were spilled due to pipeline breaks or leaks (*2*, p. 628). In addition, the frequency of pipeline failure has increased from seven incidents in 1969 to more than 40 in 1975; sediment transport appears to be responsible for more than half of these failures (*5*).

4) Another geologic hazard that is not considered is the presence of high concentrations of the light hydrocarbons methane and ethane in bottom sediments on the southern margin of Georges Bank on the upper continental slope (*6*). The presence of gas in high concentrations in bottom sediments can lead to bottom sediment instability that could result in platform or pipeline failure and spillage of large volumes of oil.

5) Travers and Luney contend that the adverse effects of OCS development can be diminished by "the implementation of tighter safety standards and closer supervision and surveillance by state and federal government officials. . . ." This argument should be scrutinized bearing in mind two important factors. First, the role of state government in OCS development is one of observer. The Supreme Court has ruled (*7*) that OCS activities beyond 3 miles offshore are under the domain of the federal government, and there has been a resulting decline in the ability of the coastal states to have influence in federal policy-making. Second, the ability of any federal government agency to diminish pollution stemming from OCS activities is limited to a great extent by the existing technology for dealing with spilled oil. While there are a number of measures that can and should be taken to prevent oil spills, there is little doubt that accidental discharges will continue and cleanup will be necessary. It is painfully clear that the technology to handle oil spills in seas greater than 5 feet does not exist. Since seas in the North Atlantic are frequently greater than 5 feet and often 15 to 20 feet (*2*, pp. 184–189; *8*), most spills that occur will undoubtedly be dispersed by the prevailing winds and currents and could affect important natural resources.

Thus, from an environmental standpoint, it may, in fact, be preferable to import foreign oil rather than produce oil from the OCS. A complete analysis of the merits and problems of OCS exploration and development, however, requires consideration of social, political, and economic factors, in addition to environmental concerns.

One final factor that should be taken into consideration is that stricter regulation of tankers could greatly reduce the amount of oil in the marine environment, lessening the impact of our current dependence on tanker imports. The Ports and Waterways Safety Act of 1972 mandated the Coast Guard to promulgate regulations on tanker design, construction, maintenance, and operations. Furthermore, as the authors have pointed out (but not emphasized), the United States can prohibit the entry into territorial waters of any ship that does not meet domestic safety requirements. While the Coast Guard for years has failed to promulgate most of the regulations pertaining to the Ports and Waterways Safety Act, recent events may inspire a more concerted effort on the part of the United States to tighten tanker safety requirements. President Carter has recommended a number of actions that the federal government can take to improve tanker safety, including requiring double bottoms, segregated ballast, inert gas systems, collision avoidance systems, and upgrading of crew training standards.

In all, however, it is clear that the United States has the legal mechanisms to substantially diminish the amount of oil spilled into U.S. coastal waters by tankers and, in light of this, the argument that OCS development will do more to decrease oil spills by reducing tanker traffic is questionable.

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We are pleased that Stewart and Devanney agree with our principal conclusion: that drilling for oil on the U.S. Atlantic outer continental shelf (OCS) is unlikely to cause a major oil spill and, consequently, "OCS development can be carried on in an environmentally acceptable fashion." We are puzzled, however, that such a long letter is needed to point out that analysis of slightly different data on recent oil spills leads them to the same conclusion as ours. We wish, as we expect they do, that better oil spill statistics existed for the years before 1972. We believe that little is gained by debates about statistical methodology when incomplete statistics are used. The crucial point is that the U.S. continental shelves are not dangerous environments in which to drill for oil. And, from a geologic perspective, the U.S. Atlantic OCS is one of the safest continental shelves in the world. Unfortunately for the debate on the environmental consequences of Atlantic OCS leasing and drilling, the critique by Stewart and Devanney contains errors, omissions, and irrelevant statistics. They ignore the geologic conditions of the Atlantic OCS and do not consider modern offshore drilling and production practices.

The alleged oil spill in 1961 from a CATCO platform off Empire, Louisiana, in all probability did not occur. Petroleum industry records, U.S. Geological Survey (USGS) data (*1*), and local newspapers contain no mention of a major oil spill in 1961 from an offshore platform. In recent interviews conducted by one of us (W.B.T.) with several oil industry engineers and USGS geologists who have worked in Louisiana since the 1950's, no one was discovered who remembered such a spill.

In the second paragraph of our article, we discussed oil spills from blowouts and said that no major spills have occurred since 1972. The sentence should have read "since 1973." In the relevant paragraph we were not discussing oil spills from pipelines. In all cases of oil spilled from platforms since 1972, the USGS reports, "No recorded environmental damage" (*1*, table C, pp. C3–C5).

In their point 3, Stewart and Devanney state that numerous blowouts have occurred in the Gulf of Mexico from 1972 to 1976, but do not mention that these were, without exception, essentially gas blowouts that spilled little oil, or more commonly, spilled no oil at all. Gas blowouts are dangerous to personnel, costly, and are certainly to be avoided, but they do not spill oil, and they do not threaten the marine ecosystem. By lumping gas blowouts with oil spills, Stewart and Devanney distort the debate over the environmental consequences of OCS petroleum development.

Further, we speculate that the hydrocarbon found on the Georges Bank and Baltimore Canyon areas will be largely natural gas because the most attractive potential hydrocarbon traps appear to us to be in sedimentary strata that were deposited in nonmarine and brackish water environments which usually generate only gas. Obviously, oil spills cannot come from wells producing only natural gas.

As further indication of the insignificance of older spills (pre-1970), we note that, in 1969, the late, highly regarded director of the USGS, W. T. Pecora said, in writing about the January 1969 Santa Barbara oil spill, "The Santa Barbara incident was the *first significant* oil-pollution experience resulting from drilling or working 7860 wells under Federal jurisdiction on the Outer Continental Shelf since 1953" [italics added] (*2*). After this statement was written, two large spills from platforms occurred in the Gulf of Mexico in 1970. Minor amounts of oil were reported on local beaches (*1*, table B, pp. B6 and B8).

Stewart and Devanney criticize us for stating that, "Offshore production and pipelines invariably introduce less crude oil and petroleum into the environment than do tankers and sources of automobile waste." We know of no data that contradict our statement. A 1975 report of the National Academy of Sciences (*3*) puts the volumes of oil spilled from platforms in perspective. Of the total input of hydrocarbon into the oceans, only 1.3 percent comes from offshore production, while tanker operations account for 34.8 percent and urban and river runoff for another 31.1 percent. A quote from a recent USGS publication (*4*) is instructive: "Furthermore, no spill in excess of 50 barrels has been recorded during *explor-*

atory drilling either on the Federal OCS or, to our knowledge, in any other offshore area throughout the world. Nevertheless, exploratory drilling is often labeled as environmentally the most hazardous aspect of offshore operations. The record does not support such contentions" (*4*, pp. 9–10).

Stewart and Devanney follow us by noting that "it would take only seven Santa Barbara spills in 1 year to exceed the spillage from worldwide tanker operations" but in doing so appear to imply that seven Santa Barbara–type spills are possible from drilling on the U.S. Atlantic OCS in a single year. The chances against seven blowouts occurring in 1 year are astronomical, and any consideration of that possibility makes little sense in a discussion of modern offshore operations and the geology of the U.S. Atlantic OCS (*5*).

Finally, we point out the logical contradiction of Stewart and Devanney's exercise in selecting certain oil spill data that they suggest could be used to favor tanker imports over drilling by a factor of 10 (their table 2). Their analysis includes numerous trivial spills of as little as 100 gallons (2 barrels), an amount of no environmental consequence. For comparison, oil spills of more than 100,000 gallons have done no environmental damage (*1*, table C, p. C1). Immediately following this discussion they say that Atlantic OCS leasing and development can be carried on in "an environmentally acceptable fashion," a curious conclusion if oil spill odds were really 10 to 1 against drilling.

Chaisson, Smith, and Fay raise several interesting points and, in doing so, plead for consideration of a wide range of environmental conditions, several of which fall outside the scope of our article. We will discuss these in the order mentioned and then consider some conclusions that may be drawn from their position.

1) Chaisson *et al.* say that the volume of oil discovered on the Atlantic OCS will be insufficient to justify the cost of sea bottom pipelines, thus requiring that tankers transport the oil ashore. We do not know what discoveries will be made; no one does. Oil finding is a difficult and chancy business, and the volume of oil available for production is discovered only by drilling and not by predictions made in advance of drilling. Many areas of the world, at one time or another, were written off as economically unattractive for oil, including Saudi Arabia, Alaska, and the North Sea. If, however, oil is discovered in the Georges Bank or Baltimore Canyon basins in quantities that require tanker transport rather than pipelines, we emphasize again that these will be *U.S. flag tankers* constructed and operated under federal regulations and not foreign tankers, some of which are unsafe.

2) Chaisson *et al.* fault us for failing to mention "the environmental consequences of the introduction of thousands of tons of drilling muds, drill cuttings, and formation waters into the marine environment." We did not mention these because their environmental consequence closely approaches zero. Drilling mud is used only during drilling and then only in very small quantities. It is composed mostly of natural mud similar to sea bottom mud. The small amounts of chemical additives (mainly lignins and alkalies) would be quickly and completely diluted by seawater in the event of a spill. Drill cuttings are small flakes of natural rock (sand, shale, and limestone) identical to rocks outcropping on the sea floor. Formation water is essentially normal seawater, a substance to which the marine biota have rather successfully adapted.

3) An important point not considered by us is that active sediment transport across the shallow Georges Bank by sea bottom currents could uncover buried pipelines. We pointed out, as do Chaisson *et al.*, that the most frequent cause of oil spills from pipelines is rupture by dragging anchors. No doubt continual monitoring of pipelines to find uncovered sections will be desirable. However, shifting sand on the sea floor can cover a pipeline as well as uncover a buried line, so that the ratio of uncovered line to covered line at any one time would be very small and the chance of rupture by dragging anchor would be proportionally smaller. Automatic shut-off devices could be placed at close intervals within the pipes so that the volume of oil spilled, in the very unlikely case of rupture, would be small.

4) Concentrations of very shallow, light hydrocarbons can cause sea bottom instability although, as Chaisson *et al.* note, these are known only on the continental slope and not on the continental shelf. No oil leasing is presently contemplated on the continental slope. Only very shallow occurrences of gas can cause slope instability and, should these be found on the shelf, they can be easily detected before platforms and pipelines are constructed, reducing the danger of accident to virtually nil.

5) We agree with Chaisson *et al.* that the federal government could reduce tanker accidents by tighter safety standards and closer supervision. However, the ability of the government to diminish pollution from OCS activities is *not* limited to the use of existing technology for dealing with spilled oil (a technology that has improved enormously in recent years) (*5*) but also includes the *prevention* of oil spills from tankers, especially where these tankers fall under U.S. jurisdiction. We join Chaisson *et al.* in urging that tankers failing to meet U.S. safety standards be prohibited from entering U.S. coastal waters. However, it is not clear that the U. S. government is willing to forcibly escort from U.S. waters tankers that fly the flags of small, Third World nations. For example, U.S.–Panama relations might suffer if U.S. Coast Guard vessels were to prevent Panamanian-flag tankers from entering U.S. waters.

We are pleased that Chaisson *et al.* note that the lack of refineries in New England causes much additional shipping of oil along the New England coast and increases considerably the chances of oil spills. Also, following their urging to consider broader matters of socioeconomics and politics, as well as environmental problems, we note that the lack of refineries in New England raises the cost of petroleum products and thereby inevitably lowers the standard of living and reduces the number of jobs in this important region. Petroleum production from Georges Bank could reduce the cost to New England of these vital products, particularly if local refineries were built. Thus, we join with Stewart and Devanney in pointing out the enormous economic gains that may result through eventual petroleum production on the U.S. Atlantic OCS. These gains may be of particular benefit to New England, and we believe they will be achieved with a net improvement to the marine environment.

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