Handler Reelected NAS President

Philip Handler has been elected to a second 6-year term as president of the National Academy of Sciences (NAS). He was reelected in mail balloting by NAS members, having run unopposed.

Handler, 57, took office on 1 July 1969. A biochemist, he was chairman of the biochemistry department of the Duke medical school at the time of his election to the top Academy post. The constitution of the Academy limits its presidents to two terms and allows the governing council to negotiate the length of presidential terms up to a maximum of 6 years. Handler and the council have agreed on a full, 6-year term.

Handler took office at a time when the Academy was under criticism for frequently providing technical advice which ignored the environmental, economic, and social implications of problems studied. During Handler's first term, a major reorganization of the National Research Council (NRC), the Academy's operating arm, was carried out. The traditional disciplinary divisions were replaced by assemblies and commissions structured, respectively, to permit more effective intradisciplinary and interdisciplinary approaches to national problems. Also important were the establishment of an Institute of Medicine within the Academy framework in 1970 and the apparent reconciliation of major differences between the Academy and the National Academy of Engineering, created in 1964 under the NAS charter.—J.W.

tion was that, given the finiteness of conventional oil resources, what goes up must come down. Oil production would do so, he said, roughly along a bell-shaped curve whose span would be an almost insignificant blip in the span of human history.

The Geological Survey in the late 1950's took—and staunchly defended—a simpler approach. It estimated the volume of sedimentary rock likely to contain oil, determined that about one-fifth of this sediment had been adequately explored by drilling, and that, therefore, four-fifths of the nation's recoverable oil remained to be found. Hubbert argued that this reasoning assumed oil would continue to be found at a constant rate per foot of exploratory drilling, whereas in reality finding rates had fallen precipitously since the 1930's and were still falling. The Survey clung to its reasoning, and Hubbert clung to its arithmetical Achilles' heel with the tenacity of a terrier.

Over the years the disagreement evolved into a professional feud between Hubbert and defenders of the Survey's estimates, chief among them the present director of the USGS, Vincent E. McKelvey. In an interesting contrast with the usual practices of government agencies, the Survey hired Hubbert in 1964. During the next decade he kept up his criticism from within, largely without effect.

The debate over oil and gas resources was generally regarded as theological until the Arab oil embargo struck in 1973 and the White House began making noises about achieving self-sufficiency at least partly through dramatic increases in domestic oil and gas production. (The Project Independence report released last November, for example, accepts the National Petroleum Council's contention that holding the price of oil at $11 a barrel could more than double the present production rate of 9 million barrels a day by 1985. The Academy report, in effect, says this is probably impossible.)

Last June, with the disagreement no longer academic, and with revised industry estimates in hand that were close to Hubbert's numbers, the resources committee agreed to arbitrate (*Science*, 12 July 1974).

The crux of the disagreement was the finding factor used by the Survey—the average ratio of oil in thoroughly explored sediments to the oil expected in a volume of unexplored rock. A ratio of one—that is, equal concentrations in explored and unexplored rock—leads to a prediction of 400 billion barrels of undiscovered, recoverable oil. A finding ratio of one-half, everything else being constant, reduces the Survey's estimate to 200 billion barrels.

In discussions with the committee's resource estimation panel, Survey officials indicated that these ratios were guesses. Hubbert, not one to guess, applied a little freshman calculus to drilling statistics and came up with a finding factor of one-tenth for the thoroughly drilled lower 48 states. Plugging this into the Survey's arithmetic gives an oil resource estimate of 120 billion barrels.

How the Academy committee arrived at its own estimate was not entirely clear, however. Besides consulting with the Survey and Hubbert, the committee spoke at length with researchers from several oil companies whose estimates were well below the Survey's. None is identified, although one certainly was Mobil Oil, whose former vice-president for research and production, John Moody, was a member of the resource estimation panel. After all these deliberations, Skinner said, the panel decided that an estimate of 105 billion to 120 billion (the median of which is 113 billion) "appears realistic."

With present technology, future discoveries plus past production and known reserves add up to a cumulative 247 billion barrels, in the committee's view, and an additional 100 billion barrels might someday be recoverable with new technology. Hubbert's comparable estimate, published last year, is 253 billion barrels.

In the end, Skinner said, it appeared to the committee that the Survey had used "misleading arithmetic," although not with any intent to deceive. "You can either guess at the [finding] factor," he said, "or you can derive it."

World Resources

What does this imply for estimates of world petroleum resources? And for the Survey's predictions of mineral resources?

Not much, apparently. Methods differ from one substance to another, and petroleum, being one of the least accessible, is one of the hardest to measure. No standard method exists for estimating this resource, but the committee accepts industry estimates that the world's undiscovered recoverable oil amounts to about 1130 billion barrels and its natural gas to 4900 trillion cubic feet. (Proved, if unmarketable, reserves of shale oil in the United States alone are said to eclipse these figures at an estimated 4 trillion barrels.)

The Geological Survey, in any event, is not conceding defeat or error. Different methods are based on different premises and are therefore hard to compare, says chief geologist Richard Sheldon. Most estimates include economic factors in one way or another,