Mohole: The Project That Went Awry (III)

By the spring of last year, Project Mohole was so beset with controversy that the Bureau of the Budget directed NSF to withhold further expenditures "until the situation is clarified."

Presumably, satisfactory clarification has now been provided, for just this week NSF received authority to proceed with Mohole along compromise lines worked out by NSF's new director, Leland J. Haworth. But in the intervening months, the Bureau—which is the White House's chief agent for controlling federal expenditures—could hardly be blamed for concluding that wisdom called for at least temporarily bringing everything to a halt. Around the time of the cutoff edict, the divergence in thinking between Brown & Root and a majority AMSOC Committee was becoming unbridgeable; AMSOC itself had developed a split on the issue of an intermediate versus an ultimate ship; NSF was being attacked on Capitol Hill for its award of the contract; and Bascom, while employed as an NSF consultant, had taken to public sniping at the performance of Brown & Root, NSF's choice for the Mohole contract. (Speaking at U.C.L.A. 2 weeks before NSF suddenly terminated his contract, Bascom declared that phase I, which he had directed, "was a tremendously successful first step. . . . But for two years, nothing more has come of it [Mohole]. It's anybody's guess when it will get off the ground.")

As for Brown & Root, its performance at the start was no spring of joy for the beseiged NSF. Clearly, the technical problems of moving from phase I (180 meters into the ocean bottom, while operating in 3300 meters of water) were trivial compared with the ultimate goal (4500 to 6000 meters into the bottom through some 4500 meters of water). In terms of the evolution of equipment and technique, it was not unlike a jump from airborne to space flight, and a quick start was out of the question, regardless of which firm or combine took on the job. In addition to the general fray over scope, technique, and objectives, skirmishes now broke out on the question of Brown & Root's competence. Senator Kuchel took to the floor to express his skepticism, and Brown & Root's public relations director retorted that it was Brown & Root's conviction that the Foundation "showed great wisdom" in awarding the contract to Brown & Root. He added, "Certainly our project manager, Bowman Thomas, has had more experience in drilling off-shore than any other human being. I presume the Foundation considered this in its decision to give us the contract." (Whether it did or not, Thomas departed Brown & Root about 3 months later to tend to his own off-shore drilling interests.)

Eventually Brown & Root put together a Mohole team that is generally considered to be a fine assemblage of engineering talent, but, as Haworth delicately phrased it when a congressional committee asked him last November to comment on Brown & Root's progress, "This was before my time, but it is my impression that the Foundation, at least individual members of the Foundation staff, probably at one time had somewhat the feeling that . . . maybe the start was a little slow."

Brown & Root Plan

In any case, in April of last year, 13 months after it received the contract, Brown & Root unveiled its recommendations for carrying out Mohole's phase II. The plan was spectacular, and so was AMSOC's reaction.

Theoretically, Brown & Root was offering no more than informed recommendations on various engineering possibilities for carrying out its contractual obligations to bore a hole to the mantle. But Brown & Root made it abundantly clear that its preference—and the bulk of its effort—had gone into designs for a floating platform, 70 by 75 meters, resting on six huge columns. The columns, in turn, rested on two submarine-shaped hulls, 112 meters long and 10½ meters in diameter. Propelled by screws on the stern of each submarine hull, the platform could travel to the drilling site under its own power. Once there, the platform would be partially submerged by flooding; propellers located in each column would operate to keep the platform stabilized above the drill pipe, in much the fashion that the outboard motors had stabilized *CUSS I*. The positioning system would be designed to maintain the craft within a 150-meter radius in 5500 meters of water, even in gale winds of 60 kilometers per hour. Construction cost was estimated at $40 million. It would cost about $9 million a year to operate; drilling time to the mantle was estimated at 2½ to 3 years.

The conclusion of Brown & Root was that the drilling art had advanced to the point where the platform could be built without going through AMSOC's proposed intermediate step. Plainly, Brown & Root was living up to its end of the bargain. It had been hired by NSF to chart a plan for drilling through the crust of the earth—the contract stated explicitly that any other objective would be separately negotiated—and the firm had come up with a proposal to drill through the crust of the earth.

However, with Brown & Root proposing to bypass AMSOC's intermediate ambitions, Hedberg lost no time in getting his committee's opposition emphatically on the record.

Having hammered away at the need for an intermediate *ship* and *program* ever since he succeeded Lill in 1962, Hedberg now presented the issue to his 19-man committe in blunt terms. Would the committee prefer, he asked in a poll, "(*a*) to get the intermediate-size vessel built now and take its chances on getting the ultimate vessel later, or (*b*) to get the ultimate vessel built now and take its chances on getting the intermediate-size vessel later." Twelve members voted for an intermediate vessel now; five favored going to the ultimate vessel at once; two did not return their ballots.

A majority of AMSOC was willing to stake the project's future on the intermediate program, and Hedberg now drew attention to an Academy-Foundation agreement, concluded a few months before, which stated that, while NSF retained final decision-making authority, "the Project should be aimed to attain as far as possible the scientific objectives conceived for it by AMSOC . . . with whom the Project originated."

Mohole had now turned into a seemingly interminable war for NSF. With

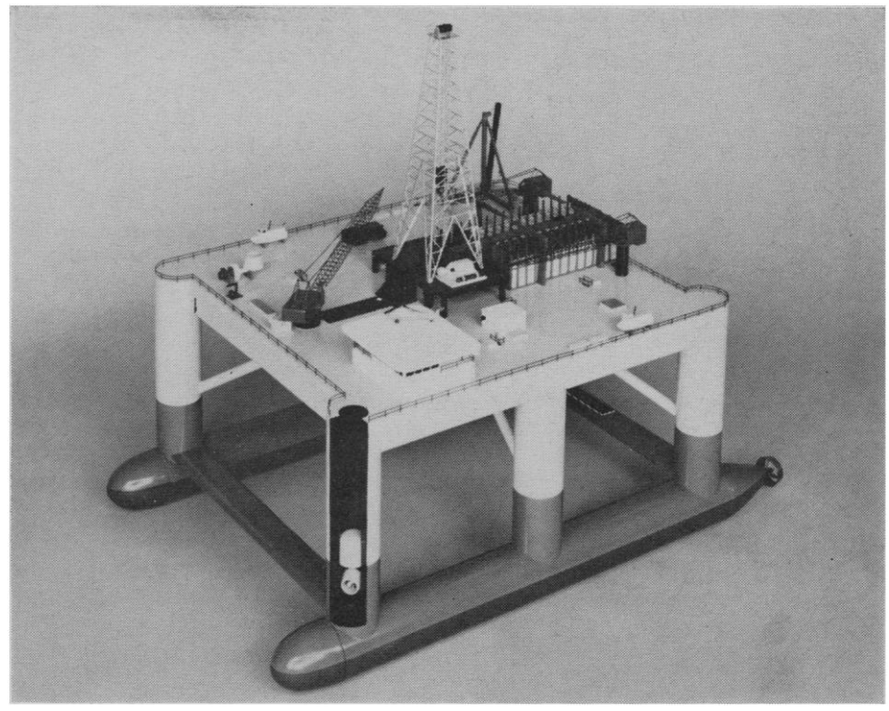
considerable justification, NSF could contend that it had come into Mohole with the understanding that it was footing the bill for a program to drill to the mantle, not for a general program of deep ocean drilling. At least five of AMSOC's own members seemed to share this conception of the project, and AMSOC's own deep drilling panel had concluded, 1 month after the Brown & Root presentation:

> It is our opinion that a properly designed floating drilling platform . . . offers the best solution of the requirements for both the intermediate and ultimate objectives of the Mohole project.

On the other hand, AMSOC's naval architecture panel had come to precisely the opposite conclusion. And Bascom's group, now on the brink of success as general oceanographic consultants, was ready and, in fact, eager to supply details for anyone looking into the hypothesis that all was not well with Mohole.

Meanwhile, the congressional critics, amply supplied with information from whatever source, kept up a barrage at NSF. And to the general dismay of the Academy and NSF, numerous snickering articles about Mohole began to break out in the popular prints. *Newsweek*, for example, came up with a piece titled "Project No Hole?" which asserted that "many top-ranking scientists have lost faith with Project Mohole." And *Fortune* came out with an article, "How NSF Got Lost in Mohole." Politicians would ordinarily shrug off such remarks as a standard occupational hazard (didn't Harry Truman once say, "If you can't stand the heat, get out of the kitchen"?). But for the leaders of the scientific community, with their traditional concern for maintaining an appearance of dignity and keeping spats out of public view, Mohole was becoming an egregiously painful sore. What they did not realize was that things would get worse.

Three AMSOC members, while retaining membership on the committee, had gone off and formed a private consortium, Oceanic Research and Exploration, Inc., to promote sedimentary and intermediate exploration. Today, nearly a year later, nothing has come of their efforts, but their move did nothing to contribute to an appearance of unanimity within AMSOC. And a month after the establishment of the consortium, the Bureau of the Budget took a long-expected step when it curtly advised NSF that the situation called for putting a brake on further expenditures. Writing to NSF Director Waterman, the head of the Bureau stated:



Mohole drilling vessel, as proposed by Brown & Root. The huge platform is supported by six columns which rest on twin submarine hulls. Traveling to the drilling site under its own power, it would be partially submerged and stabilized on site with propellers housed in each column. Construction cost is estimated at $40 million; annual operating cost at $9 million.

> You will recall that when this [post CUSS I] phase of the project was brought initially to our attention, total costs of $15 to $20 million were anticipated. Last fall, when a request for $15 million was included in the budget for further funding, a total cost in the neighborhood of $50 million was discussed. Since then your [latest] congressional presentation . . . states that the Foundation regards $50 million as a minimum figure and that the ultimate total may be considerably higher.
>
> Given the financial as well as the technical uncertainties, together with the unique administrative problems involved in a project of this magnitude . . . I believe the Foundation should withhold its approval of further financial commitments . . . until the situation is clarified.

(In August, shortly after Haworth became head of the Foundation, the Bureau of the Budget, upon his request, released an additional $2 million to prevent Brown & Root's design efforts from coming to a complete halt. But no funds were allowed for construction, leaving total Mohole expenditures, from the very beginning until the present, at slightly over $7 million.)

In the meantime, NSF itself was seeking a way out through a special study convened by its senior advisory body, the National Science Board.

Such was the state of affairs this past fall when both the House subcommittee on oceanography and NSF's Senate appropriations subcommittee decided to take a long look at Project Mohole. The House committee, which does not have specific jurisdiction over NSF, apparently was just looking into the affair to find out what it was all about, but the Senate committee, with direct money authority over NSF, was keenly interested, and especially so was one of its members, Senator Allott, the Colorado Republican who had been blasting NSF ever since it passed by one of his constituents and awarded the contract to Brown & Root. The effect of these inquiries was to disabuse anyone of the notion that things were so bad that they could only improve.

A star witness at both proceedings was AMSOC Chairman Hedberg, who came on like a rock-eating drill. Informing the committee that "personally I would far rather see this project killed where it now stands than to see it carried out in a manner not worthy of its potentialities," Hedberg warned that "there must be insistence that it not be allowed to degenerate into merely another publicity stunt." Continuing, Hedberg declared:

> . . . this project can readily be one of the greatest and most rewarding scientific ventures ever carried out. I must say also that

it can just as readily become instead only a foolish and unjustifiably expensive fiasco if there is not an insistence that it be carried out within a proper concept and in a well-planned, rigorously logical, and scientific manner. . . .

It is my opinion that there is a steadily growing ground swell of informed public opinion against the thought of a poorly planned, foolish, and extremely costly attempt to unnecessarily "shoot the works" by trying to drill an ultradeep hole to the mantle before we have anywhere near enough information on the rocks above the mantle. . . . The initial false glamor of the Mohole idea is wearing off in the face of realities, and I am sure that the informed public now finds a much greater appeal in a broad sensible program of crustal investigation carried on at a moderate rate rather than in a crash Mohole stunt.

Mixed into his emotionally stated position, however, were some extremely compelling arguments for the intermediate-ship approach.

The Brown & Root platform, he pointed out, could not transit the Panama Canal. It could go the long way around, but, clearly, its mobility was limited. Furthermore, Hedberg said, alluding to the argument that the mantle was the agreed-upon and only objective, "even supposing the project had been mistakenly presented in such a shortsighted or misleading way, nothing has happened to date which would preclude its being adequately redefined now. . . ."

Long-Term Goals

The case for the intermediate ship, he asserted, rested not only on the need to accumulate data for design of the ultimate vessel, but also on the need to develop an orderly and long-term program.

. . . we should be thinking of a continuing program in subocean-bottom drilling research which will inevitably be a long process, but which need go no faster than its early results justify. If we get encouraging results from early intermediate-depth drilling, this may constitute adequate justification to make everyone glad to go ahead with the preparation of an ultimate Mohole vessel. On the other hand, it is not at all inconceivable that early results may indicate that there is either no need or no possibility of drilling to supposed Mohole depths, in which case it would have been a reckless disregard of taxpayers' money to have prematurely or needlessly built the huge vessel now proposed. . . .

Whatever the technical merit of Hedberg's argument, the impact was enormous. Academy President Seitz promptly reprimanded him for presenting "such formal testimony to the Congress without first clearing your proposed testimony with me. . . ." Seitz added that unless Hedberg would agree to consult him on communications with "any organization or agency outside the Academy . . . so that I can decide whether your communication merits the attention of the (Academy) Council . . . I will have no choice but to request the Council to permit me to reconsider your own status as chairman of AMSOC."

Hedberg promptly submitted his resignation in a characteristically tart letter that concluded with the hope that "some of the hysteria which seems to be surrounding this Mohole Project will soon be dispelled under wise leadership by you (Seitz) and Dr. Haworth." He also pointed out that he had attempted to discuss his forthcoming testimony with Seitz, but the Academy president was tied up at the time with preparations for the Academy's centennial celebration, and he added that in testifying he had made it clear that he spoke for himself and not for the Academy. And thus, Hollis Hedberg, who had headed AMSOC for nearly 2 years, stepped out of the picture.

His testimony, however, seems to have hit home with the Senate appropriations committee, for it was soon to issue a report stating that "Such a diversity of scientific and engineering opinion has been presented . . . that it is obvious that construction of a large drilling platform at this time would be unwise." The committee accordingly directed that further expenditures on the platform be withheld, but later retreated from this position when, in conference with Rep. Albert Thomas's committee, it was decreed that funds would be provided for NSF and the Bureau of the Budget to "use good judgment and work out a sensible proposition."

Mohole Solution

A proposition, however sensible, has now been worked on terms devised by Haworth, who, in his first half-year as NSF director, has devoted more time to Project Mohole than to any other Foundation activity. As proposed by Haworth, Brown & Root will be given authority to build the *ultimate* platform, but the platform will initially be equipped with an *intermediate* drilling rig. By following this course, he testified, the Foundation was recognizing the mantle as the ultimate objective, but, while minimizing the costs, would benefit from the experience gathered in intermediate drilling.

Haworth went on to say that he favored a "supplementary drilling program," not directly associated with Project Mohole, that would presumably carry out the upper-level explorations advocated by members of AMSOC. And, he added, "with the advantages of hindsight, I regret that the work of Brown & Root was not paralleled by a continuous drilling program directed both at the development of equipment and techniques." Haworth also pointed out that it was his hope eventually to turn over Mohole's management to a university or an oceanographic research institution, and thus to have it run on what has come to be the standard basis for handling big projects financed by the Foundation.

The Haworth proposal was, in effect, an attempt to find some common ground among the parties that had for so long been enmeshed in the Mohole controversy, and, apparently it has succeeded. The Bureau of the Budget has given the Foundation authority to go ahead with an ultimate platform rigged for intermediate drilling. In this tight budget year, however, the supplementary ship had been put aside, but it is understood that the Bureau accepts it in principle. And an effort is now being made to bring an outside institution into the project, though nothing definite has yet been arranged.

End of AMSOC

As for AMSOC, it's going out of business. At a meeting this past weekend in Washington, Mohole's originators are reported to have agreed that it would now be wise to dissolve the committee and reconstitute it into a group that would be concerned only with the scientific aspects of Mohole. A separate Academy group to provide engineering advice may also be established. Just what this means remains to be seen, since it would seem to be a difficult matter to dissociate Mohole's science from its engineering. But with Haworth firmly taking charge, AMSOC was in no position to promote any new squabbles. Nor was the Academy willing to tolerate a continuing source of dissension on its premises. (Academy officials have long felt that AMSOC, beginning with its whimsical title, was an inappropriate body to be housed under the Academy's prestigious roof.)

One final development is that NSF, in its determination to keep tight control over the project, has engaged Gordon Lill, AMSOC's first chairman, to join the Foundation staff as Mohole director. Lill, who is now with Lock-

heed, is expected to take up his duties about mid-February.

The sentiment at the Foundation, as expressed by one official long associated with Mohole, is that "everyone made lots of mistakes." At this point, everyone involved is eager for peace and progress, and it would therefore appear that Mohole now has reasonable prospects for proceeding, with nothing but technical difficulties to occupy its time and energies. However, on the basis of past performance, even the most thorough-going optimist could not be blamed for withholding judgment.

—D. S. GREENBERG

(This concludes a three-part series on Project Mohole.)

Budget: Requests for R&D Funds Edge above $15 Billion Mark for a Fiscal Year of "Austerity"

Because of the most unusual circumstance that President Johnson is submitting his first budget in a Presidential election year, this budget, which was unveiled this week, is naturally receiving close scrutiny as a political and economic document.

Economy has been a Johnsonian watchword since he was propelled into office just 2 months ago and now he has presented what he calls a "restrictive budget." He proposes a somewhat reduced administrative budget for the 1965 fiscal year—$97.9 billion compared with $98.8 billion last year—and a cut in the number of federal civilian employees. As a result of an anticipated increase in federal receipts the President foresees a '65 deficit of $4.6 billion or about half the estimated $9 billion deficit for the current fiscal year, which ends 30 June.

At the same time, President Johnson pledged himself to austerity without stagnation and made his "attack on poverty" a dominant theme in the budget message. As a result the budget is being examined carefully to see how the administration proposes to do more for less.

At this stage, however, it is extremely difficult to put the budget into close focus. The federal agencies are ordered to keep mum on their own budgets until the big budget goes to Congress, primarily because the administration, understandably, wants to exploit the occasion to speak in general terms, to discuss round numbers and big ideas. Major agencies with vast and complicated budgets, such as the Defense Department and National Aeronautics and Space Administration, hold full-scale press briefings in the days immediately before the release of the budget, but in many cases it is still too early in the game to get anything but provisional answers to questions on specific programs. This year, the job of early analysis is even more troublesome than usual because the budget appendix, the fairly detailed form of the budget which is about the size of the telephone directory of a medium-sized city, is not yet available. This is proof of a kind that the new President and his advisers did tear up the budget in some places and insist on revisions.

It should be remembered, however, that the budget as a document with retrospective tables is a more reliable guide to what happened than to what is going to happen. Circumstances alter budgets and the national economy and the international situation are unpredictable. In matters of federal spending it is the President who proposes and the Congress which disposes, and last year Congress appropriated some $6.5 billion less than President Kennedy requested.

Budget Expenditures for Research and Development (in millions of dollars).

Fiscal year	Defense	NASA	AEC	HEW	NSF	Other	Total
1960	5654	401	986	324	58	315	7,738
1961	6618	744	1111	374	77	356	9,278
1962	6812	1257	1283	512	105	409	10,373
1963	6849	2552	1335	621	142	483	11,983
1964	7450	4400	1543	754	175	561	14,883
1965	7107	4990	1557	796	204	633	15,287

Signs and Portents

The budget and the message which accompanies it, however, are still worth examining for signs and portents of the administration's intentions and probable priorities.

For those speculating about the course of science policy in the Johnson administration, the omens in the budget are not strikingly clear. Spending on science is up, but the sharply rising curve of recent years would flatten decidedly next year although it is likely that the same thing would have happned if this had been a Kennedy budget.

The total request for federal expenditures on research and development for fiscal 1965 is $15.3 billion as compared with an estimated $14.9 billion to be spent in the current fiscal year, an increase of only 3 percent in '65 over '64 as compared with a 24 percent rise in '64. This leveling off can be traced mainly to the peaking of the space budget and to changes in the goals of defense research. Growth in the science budget in the coming year, if the Johnson recommendations prevail, would still be attributable to expansion of NASA research and development activities.

Five agencies dominate the science budget: the Department of Defense, NASA, the Atomic Energy Commission, the Department of Health, Education and Welfare, which is the parent agency of the National Institutes of Health, and the National Science Foundation. Figures for federal R&D expenditures for the four previous years and estimated figures for the current and coming fiscal years are given above.

The lumping together of funds for basic research and development and for construction of R&D facilities has long clouded the picture of federal support of science. This year in the compact official paperback, *The Budget of the United States Government* (available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.; $1.50), separate totals for research, development, and facilities are offered for the first time.

The subtotal for research in the 1965 request is $4.3 billion compared with an estimated $4.1 billion expenditure in the current year; for development, $9.8 billion for '65 compared with $9.7 billion in '64, and for R&D facilities, $1.5 billion in the next fiscal year compared with $1.1 billion this year.

According to the special analysis contained in the budget summary mentioned above, almost two-thirds of federal funds for research and development are spent through contracts with private industry. Slightly more than 20 percent goes into R&D activities by scientists and engineers in federal laboratories and only some 13 percent of federal R&D funds are spent through contracts and grants to universities and other nonprofit institutions.

Also provided this year is a table showing expenditures for conduct of