will soon be invited to join the Hughes club.

So, first the school is chosen. Then, the eligible departments. At some places, more departments are eligible than at others. Informally, deans or department chairmen are told how many candidates to submit, and internal screening committees are set up to decide which young researchers on the faculty seem best to fit the Hughes bill. "Some years, we know we can submit only one candidate. Other years, they let us know that a couple of slots may be available. It's all meant to seem very casual, but you know it isn't," said one of the persons who chooses Hughes candidates for his school. A candidate or two is chosen by the school and then applies for an investigatorship. When asked why they had applied to the Hughes Institute, most of the investigators *Science* queried replied, "Because my department chairman told me to."

The applications of the prescreened candidates are then examined in Miami by the medical board that makes the final cut, usually turning some applications down to show that there really is a selection process going on. Then, the winners are notified. Most of them find the whole business somewhat odd but don't pay much attention to it. They say that they continue to do the research they had been doing and feel under no pressure to do anything in particular to satisfy "the boss," except to write those reports that stay buried in Miami. And being, for a time, an "employee" of the Hughes Institute apparently does not change much one way or the other as long as their relationship with their universities remains secure. Being a Hughes investigator is like having an NIH career-development award, only its different. It's not a "grant," or so they say.

Apparently the members of the executive committee of the Institute recognize that the distinction between an "investigator" and a "fellow" or "grantee" is a somewhat tenuous one when it comes to proving that they are running an operating research organization, because they have called for a new strategy. In addition to supporting young individuals, to the tune of $30,000 to $50,000 a year apiece, the Institute is planning to support what one man called "a senior investigator and all his show," meaning everyone in the laboratory right down to the bottle washers. In these cases, the Institute would be making commitments of several hundreds of thousands of dollars at a time. It is interested in "employing" senior scientists working in genetics, immunology or endocrinology, and metabolism.

In these days of tight budgets and dwindling research funds, what medical school deans would like most is to have someone come along and say, "Hello. I'd like to foot the bill for your department of genetics." Sounds good. But what if, after a couple of years, the Hughes Institute changes its mind about supporting whole groups. Then, it's back to NIH, which may not be making any new awards, even to those whom it had supported for years. What then? Schools acknowledge their concern about the risk they see in taking Hughes money under these terms, but several have decided that it is an acceptable risk. Preparations are being made for the establishment of "Hughes laboratories" at Harvard, the University of California at San Francisco, Duke, Vanderbilt, Hopkins, and the University of Washington, among others.

The new pattern of Hughes funding is clearly tempting, if slightly discomfiting. What remains to be seen is whether the IRS will buy it as evidence that the Institute really is something other than a private foundation.

—BARBARA J. CULLITON

Office of Technology Assessment: Bad Marks on Its First Report Cards

The Office of Technology Assessment (OTA), which was established in 1972 in an effort to boost the analytical capabilities of Congress, has come under criticism for alleged failures to perform up to expectations.

The first darts to be tossed at the agency were thrown by Harold Brown, president of Caltech and first chairman of the Technology Assessment Advisory Council, a group of 12 outside experts who meet periodically to offer advice to the board that runs OTA. In a letter of resignation submitted 10 December, shortly before completing his service as advisory chairman, but only recently made public, Brown lamented that "few of us on the Council, I believe, would say that we are satisfied with what has been accomplished, compared with what we hoped for and still believe possible."

This rather mild rebuke was followed by a more harshly worded critique published in June by the House Commission on Information and Facilities, a unit that was set up to study the various information services available to the House. In its first report—devoted to OTA—the commission concludes that "OTA remains substantially short of reaching levels of performance reasonably expected of an information resource of its size and cost and access to expertise." It attributes OTA's shortcomings to ambiguities in the law that established the agency, the inherent difficulties of performing technology assessments, and the "youth and inexperience" of the office.*

**The Office of Technology Assessment: A Study of Its Organizational Effectiveness*, House Document No. 94-538, issued by the House Commission on Information and Facilities, Washington, D.C., 18 June 1976.

The criticism comes at a time when OTA has been functioning for little more than 2 years, so it must be read, not as a final judgment, but as advice offered to correct alleged weaknesses that have been discovered during the start-up process.

Some of OTA's difficulties stem from an unusual tripartite structure. At the top is the Technology Assessment Board, a bipartisan body of six senators and six representatives, currently chaired by Representative Olin E. Teague (D–Tex.), which sets policy and acts as an oversight body. Reporting directly to the board is the full-time director of OTA—currently Emilio Q. Daddario, a former congressman—who sits as a member of the board and acts as chief executive officer for the entire operation, including staff and outside consultants. The third major element in the structure is the advisory council, which reports to the congressional board.

In its brief existence, OTA has grown rapidly, reaching an appropriations level of $6.05 million and employing the equivalent of 89 full-time personnel in fiscal year 1976, the current year. The agency conducts a variety of studies, some

self-initiated and some at the request of congressional committees, with the work being done by a mix of outside contractors, advisory panels, and professionals on OTA's own staff.

Perhaps the most significant criticism leveled at OTA is that it has been squandering its energies on routine tasks for congressional committees while failing, in the words of Brown, "to provide an early warning system for the Congress, so that [Congress] can consider the social and other impacts of technological advances . . . before those effects are upon us." Brown's solution for this failing is to have OTA turn down more committee requests, particularly those that do not really call for technology assessments but rather seek technical feasibility studies, reviews of existing programs, literature searches, or economic studies—jobs which might better be performed by other research agencies that have greater resources. The House commission offers a less emphatic proposal. After noting that there is "doubt and uncertainty" about the extent to which OTA should perform long-term, in-depth technology impact studies (the goal of most of the original supporters of OTA), the commission recommends that OTA develop a definition of just what technology assessment is and what kinds of projects it will undertake.

Brown and the commission diverge sharply on another major issue—the extent to which OTA should use in-house staff or outside experts to conduct its studies. Brown called for "more in-house capability" and suggested beefing up the staff, which he said "has not hitherto been uniformly of a professional background such as to allow substantial studies to be done entirely in-house." But the commission noted that, while most of the original sponsors of OTA viewed it as a contracting agency, that function is rapidly becoming a secondary one. By fiscal 1977 only 48 percent of the agency's budget will be spent for contract services, down from 66 percent 3 years earlier. The commission found some reasonable explanations for this trend, but concluded that it was exacerbated by OTA's failure to develop competence in contract management. The commission came to no conclusion about the proper balance between inside and outside work, but OTA chairman Teague, in a letter responding to Brown's suggestions, said there could be no drastic shift toward in-house studies. "OTA was sold to the Congress from start to finish, House and Senate, as a *contract* operation," he wrote. "It was also sold on the basis of a small but highly capable in-house staff. I can say in all candor, as one who must justify OTA's budget to the Appropriations Committees each year, that OTA would be unfunded today without those assurances." †

Neither Brown nor the commission offered much criticism of the substance of OTA's work thus far. Brown, in fact, specifically praised a number of OTA reports as "both of good quality and considerable utility." These included a study of drug bioequivalence, a review of the budget of the Energy Research and Development Administration, and a study of nuclear effects, among others. The agency's reputation among outsiders, Brown added, is "mixed." In a similar vein, the commission's staff concluded: "Committees that have requested and received studies have mixed reactions concerning OTA responsiveness. The prevailing attitude ranged from pronounced dissatisfaction to rather high praise, but centered generally in the area of qualified approval."

Much of Brown's letter of resignation was devoted to lack of communication and cooperation between the other two components of OTA and the science advisory council, which he acknowledged is "probably the least important" of the three elements. "Often, Council members have had very little time to comment on proposed assessments before TAB [Technology Assessment Board] approval," he complained. "I understand that this may frequently be the result of a need for rapid response by the Board to Congressional Committee requests. Nevertheless, these and other situations have led us to question the Council's effectiveness and value. . . . at one time or another most Council members have expressed frustration about the relatively large amount of time, effort, and persistence that they have invested in terms of the effect that they feel they have had." Then, in a plea typical of the adviser who feels neglected, Brown recommended regular breakfast or luncheon meetings between council

†The exchange of correspondence between Brown and Teague is reprinted in Appendix F of the *Annual Report to the Congress by the Office of Technology Assessment*, 15 March 1976, available for $1.55 from the U.S. Government Printing Office, Washington, D.C. 20402, stock number 052-003-00152-7.

Staff Gets High Pay, So-So Rating

The Office of Technology Assessment (OTA) pays "exceptionally high" salaries to its staff, many of whom are designated for appointment by the senators and representatives who sit on the OTA board. The salaries are not only above the government-wide average, as would be expected because of the concentration of high-level professional staff at OTA, but are "significantly higher" than the average salaries at such comparable agencies as the Congressional Research Service, the General Accounting Office, and the National Science Foundation. These findings are reported by the staff of the House Commission on Information and Facilities in a recently released management study of OTA.

According to the study, OTA "follows no uniform standards of salary determination" and "salary often bears little relationship to discernible qualifications or identifiable responsibilities." Almost one-fourth of the professional staffers (16 out of 66) receive the maximum allowable salary of $37,800 a year. One-eighth of the professional staffers (8 out of 66) were designated for appointment by members of the congressional board. One such designee received a salary boost of $10,000 a year when he was transferred from the member's office to OTA. Another, an attorney only 4 years out of law school, was earning $37,800 within a year of moving from a member's office to OTA. And a third, who apparently had only 1 year of experience as a fellow in the same board member's office, moved into OTA at nearly $25,000 a year. Meanwhile, a young political scientist who had been earning only $8,000 a year teaching, was hired by OTA at more than $26,000 a year.

How good is the professional staff? That question was addressed in a poll of the outside experts who sit on the advisory council to OTA. The council members were asked to rank competence on a scale ranging from 1 (deficient) to 5 (outstanding). They gave the professional staff an average score of 3.25, with some votes registered at both ends of the scale.

The congressional board got the worst marks—its executive leadership was rated at only 2.75. Leadership from the director's office was deemed slightly better, at 3.25. The quality of the administrative staff was rated 3.50 while the quality of the outside experts and consultants used to conduct studies was judged highest, at 4.00.—P.M.B.

members and the board and OTA staff heads. However, Teague, in a reply typical of the power-wielder in such situations, said this might be "difficult" because congressmen are so awfully busy.

Whereas Brown's letter is a brief personal impression of how OTA is working, the commission's report is primarily a management study conducted by two auditors from the General Accounting Office, a part-time management consultant, and three staff members supplemented from time to time by other congressional staffers. It lambasts OTA for a host of alleged organizational, administrative, and definitional failings, including lack of "orderly structure," failure to delegate authority and responsibility (42 percent of the professional staff claimed they report directly to the OTA director), lack of a personnel program, defective accounting procedures, and poor internal communications, among other sins of commission and omission. Yet the report occasionally verges on self-contradiction and reaches hard to make the case that, while OTA has not yet been tripped up significantly by its administrative shortcomings, it may well find itself in trouble in the future.

After citing all the supposed organizational flaws, for example, the commission concludes that "To date, OTA has managed to minimize the more disruptive manifestations of its organizational and administrative weaknesses." Then it warns that, unless corrective action is taken, the flaws will limit OTA's long-term performance. Similarly, on the major concern that led to establishing the commission's study in the first place—the fear that OTA would duplicate the work being done by the General Accounting Office and the Congressional Research Service—the commission found no significant duplication among some 441 reports issued by the three agencies over a 7-month period. It attributed this record to "a high degree of sensitivity" by OTA program managers. Nevertheless, it warned that there is a "potential for duplication" because, while OTA has some procedures for avoiding duplication, it has no "established checklist" of steps to be taken to avoid duplication. In the eyes of some OTA supporters, the commission's critique reads like the view of management consultants who were more interested in organizational charts than in actual performance.

The only public response by OTA to the commission's criticisms was a bureaucratically opaque statement by OTA director Daddario, who called the critique "useful" and promised to study it carefully. "There is always a question as to how far a new, small, flexible agency should go in formalizing its procedures," Daddario said. "We welcome this contribution to that discussion."

—PHILIP M. BOFFEY

Recombinant DNA: Chimeras Set Free Under Guard

Guidelines governing research on recombinant DNA were issued in final form by the National Institutes of Health last month, bringing to close a 2-year period of debate-cum-moratorium during which most such research has been held in abeyance.

The guidelines do not differ in any serious way from the version agreed on 6 months ago by the NIH recombinant DNA committee (*Science*, 19 December 1975). They apply only to NIH grantees and do not have the force of law because the NIH does not at present intend to issue them as regulations.

An accompanying position paper prepared by NIH director Donald S. Fredrickson explains why certain objections to the guidelines have been ignored. One major criticism, advanced by Robert Sinsheimer of Caltech, is that the recombinant DNA technique compromises the barrier to genetic exchange which nature seems to have set up between bacterial and higher cells (*Science*, 16 April 1976). Fredrickson cites a counterargument to the effect that such exchange probably occurs all the time but is not detected because the organisms in question fail to survive. "The fact is that we do not know which of the above-stated propositions [Sinsheimer's or the counterargument] is correct," Fredrickson observes. The conclusion, while doubtless true, leaves Sinsheimer's theorem unrefuted and his objections, at least on their own terms, unanswered.

Another major issue in the debate has been the use of the human gut bacterium *Escherichia coli* as host for the recombinant DNA's. The two major critics of the guidelines, Sinsheimer and Erwin Chargaff of Columbia University, have both suggested that the host should be an organism which does not dwell in man or the human environment. (Besides man and warm-blooded animals, the known habitats of *E.coli* include fish, insects such as beetles, grasshoppers, and flies, and the soils of both densely and sparsely populated regions.) Fredrickson's response is that the wealth of existing knowledge about *E. coli* and its genetic makeup will make it a safer host than any other bacterium. Nevertheless, Fredrickson says, the NIH "recognizes the importance of supporting the development of alternative host-vector systems," such as those that have no ecological niche in man.

Measured against an absolute standard, the NIH guidelines may be less than foolproof on these and other points. Probably the fairer and more pertinent test of their acceptability is whether they faithfully translate into practical directives the general principles laid down at the international conference at Asilomar last year. The conference document, agreed to by all 150 or so delegates, and later adopted by the NIH recombinant DNA committee, stated that ignorance about the implications of the recombinant DNA technique "has compelled us to conclude that it would be wise to exercise the utmost caution." In the printed version of the document, which lacks the original's clarity of style, and possibly of definition as well, the five-man organizing committee of the conference has altered the words "utmost caution" to "considerable caution" (*Science*, 6 June 1975).

> Paul Berg of Stanford, a member of the organizing committee, says that no relaxation of standards was intended by the rewording, and that he sees "no substantial difference" in the change.

It could perhaps be argued that the NIH guidelines do not enjoin the "utmost" caution, because yet more cautious positions can be envisaged, such as avoiding the use of *E. coli* as a host*, or

*"You are . . . undoubtedly correct [in principle] that *E.coli* is the wrong microorganism," wrote DeWitt Stetten, NIH deputy director for science and chairman of the NIH recombinant DNA committee, in a letter of 6 October 1975 to a critic on this point. "Even at the Asilomar Conference, however," Stetten added, "I detected little interest on the part of the majority to table *E.coli* and begin again from scratch with some other organism. The enormous quantity of accumulated information about *E.coli* appeared to dictate that, despite its hazards, this was still the organism of first choice. . . . I should expect that were we to make regulations banning activity in this or any other field of science for a number of years, we should find these regulations very difficult or impossible to enforce."