terest. First, they claimed that, because "no clear-cut medical or professional standards were in force or were violated" by the two physicians, the attempt to find them guilty had an ex post facto quality. They also argued that the charges did not accurately fit the case. Testimony was introduced from well-known cancer and other professional researchers, including I. S. Ravdin, vice president for medical affairs of the University of Pennsylvania, and George E. Moore, director of Roswell Park Memorial Institute, to the effect that Southam's practices did not differ dramatically from those of other researchers. "If the whole profession is doing it," one of the lawyers remarked in an interview, "how can you call it 'unprofessional conduct' "? The lawyers also argued that the "fraud and deceit" charge was more appropriate to low-brow scoundrels, such as physicians who cheat on insurance, supply illegal narcotics, or practice medicine without a license, than to their respectable and well-intentioned clients.

Voice of the Public

To all arguments of humane motivations, extenuating circumstance, conflicting testimony, or legal ambiguities, the final answer of the Regents was very simple: It is no excuse. There was never any disagreement on the principle that patients should not be used in experiments unrelated to treatment unless they have given informed consent. But in the Regents' decision, two refinements of that principle are heavily stressed. The first is that it is the patient, and not the physician, who has the right to decide what factors are or are not relevant to his consent, regardless of the rationality of his assessment. "Any fact which might influence the giving or witholding of consent is material," the Regents said. "A patient has the right to know he is being asked to volunteer and to refuse to participate in an experiment for any reason, intelligent or otherwise, well-informed or prejudiced. A physician has no right to withhold from a prospective volunteer any fact which he knows may influence the decision. It is the volunteer's decision to make, and the physician may not take it away from him by the manner in which he asks the question or explains or fails to explain the circumstances. There is evidenced in the record . . . an attitude on the part of some physicians that they can go ahead and do anything which they conclude is good for the patient, or which is of benefit experimentally or educationally and is not harmful to the patient, and that the patient's consent is an empty formality. With this we cannot agree."

The second principle stressed by the Regents is that the physician, when he is acting as experimenter, has no claim to the doctor-patient relationship that, in a therapeutic situation, would give him the generally acknowledged right to withold information if he judged it in the best interest of the patient. In the absence of a doctor-patient relationship, the Regents said, "there is no basis for the exercise of their usual professional judgement applicable to patient care." Southam, in an interview, disagreed. "An experimental relation has some elements of a therapeutic relationship," he said last week. "The patients still think of you as a doctor, and I react to them as a doctor, and want to avoid frightening them unnecessarily." Mandel takes a similar position. In a letter to the editor of a medical affairs newspaper he stated: "In accordance with the age-old motto—primum non nocere—it would seem that consideration of the patient's well-being may, at times, supersede the requirement for disclosure of facts if such facts lack pertinence and may cause psychologic harm." But on this point, the Regents are clear: "No person can be said to have volunteered for an experiment unless he had first understood what he was volunteering for. Any matter which might influence him in giving or withholding his consent is material. Deliberate nondisclosure of the material fact is no different from deliberate misrepresentation of such a fact."

In closing their case, and acknowledging that the penalties imposed were severe—they might have just authorized a censure and reprimand—the Regents were pointed and succinct: "We trust that this measure of discipline will serve as a stern warning that zeal for research must not be carried to the point where it violates the basic rights and immunities of a human person."

What the impact of the case will be is by no means clear. The Regents' decision outlines clear rules for a very narrow situation and attempts to set out some broad principles as well. But it is by no means binding, and it by no means covers the variety of situations with which researchers seeking to use human subjects are faced. The question is, What will cover these situations? Codes and declarations, of which there are already several, are too general to offer specific guidance. Researchers and patients alike are too vulnerable to await a slow case-by-case accretion of specific rulings. One alternative is the development within each hospital or research institution of "ethical review committees" that could define the consent-and-disclosure requirements for each proposed experiment and see that they were adhered to. In theory, this is already taking place. During the Southam-Mandel hearings, the state attempted to prove that Southam, a recipient of an NIH grant, had violated regulations of the Public Health Service. In fact, the regulations in question govern only the normal volunteer program of the NIH Clinical Center in Bethesda. The PHS response to an inquiry from New York's Attorney General made clear that the rules were not generally applicable and stated that, "in supporting extramural clinical investigations, it is the position of the Public Health Service that proper ethical and moral standards are more effectively safeguarded by the processes of review and criticism by an investigator's peers than by regulation."

That is the theory, but the trouble is, it is not yet being done. And, given the tremendous growth and variety of medical research involving human beings, if it is not done by the scientific community, someone else will start to do it. The New York Regents may be only the beginning.—ELINOR LANGER

Manpower: Output of Scientists and Engineers May Exceed Goals Set by White House Committee

Supply-and-demand studies about manpower in science and engineering involve many imponderables and uncertainties, but current forecasts for the production of well-trained people in these fields are encouraging to those who have feared shortages. Indeed, the outlook is remarkably good in view of the concern that was being expressed a few years ago.

In January 1962 the late President Kennedy spoke of the "inadequacy" of the supply of scientists and engineers and asked his Science Advisory Committee (PSAC) to review the problem and report on possible remedial action. The PSAC panel which undertook the study, one chaired by Edwin R. Gilliland, professor of chemical engineering at M.I.T., focused its attention on the need for more productive graduate programs in three areas—engineering,

mathematics, and the physical sciences (EMP). Graduate programs in the health-related sciences, already receiving substantial support from the National Institutes of Health (NIH), were deemed far better equipped than EMP programs to meet manpower demands.

The goals set by the panel and endorsed by the administration were (i) to increase the number of doctorates awarded in EMP fields to 7500 a year by 1970 and (ii) to increase the number of students completing a full year's graduate training (considered roughly equivalent to earning a master's degree) to 30,000 a year during 1970. The panel recommended greater government and nonfederal support for EMP students and programs and called for the development of "new centers of excellence" (a term which quickly gained currency).

Now, 3 years after the Gilliland report, the prospect is that the panel's goals will not ony be met but exceeded —unless, of course, the Vietnam conflict erupts into a major war. (If the conflict remains at its present level, or even if it should grow somewhat larger, the effect on students, graduate programs, and federal scholarship and institutional aid will be positive as well as negative. A tighter budgetary situation eventually could mean retrenchment in some federal programs or at least could discourage new commitments. On the other hand, students returning from Vietnam are virtually certain of support under a new "G.I. Bill of Rights," now approaching passage in Congress. Students now in graduate school and the abler undergraduates who plan to do graduate work are likely to escape the draft so long as they make good progress toward their educational objectives.)

Though describing its goals as reasonable and attainable, the Gilliland panel was "gravely concerned" about their attainment. Production of degrees in EMP fields in 1960 was 2927 doctorates, 12,311 master's. An output of 7500 doctorates and 30,000 master's in 1970 would mean increasing production by approximately 150 percent during the 1960's. The panel, noting that the number of new doctorates had increased by only 50 percent during the 1950's, said that even to increase production to 5500—the number then projected by the U.S. Office of Education—would entail a "considerable increase in support of all kinds for students and universities alike."

Although the panel's recommendations have been carried out only in part, the production of degrees has been mounting faster than expected. Doctorates awarded in EMP fields last year totaled 5110, and the current Office of Education projection is 7890 in 1970. Master's degrees awarded in 1965 totaled 21,560, and the projection for 1970 is 38,550. Projections for 1975 are 12,660 doctorates, 55,510 master's. (See Table 1 for projections by EMP field.)

Table 1. Number of degrees awarded in EMP fields in 1960 and 1965, and numbers projected by the U.S. Office of Education for 1970 and 1975.

Year	Engineering	Mathematics and statistics	Physical sciences	Total EMP
		Bachelor's degree		
1960	37,808	11,437	16,057	65,302
1965	36,560	21,270	18,580	76,410
1970	49,720	41,660	28,410	119,790
1975	53,040	60,390	34,380	147,810
		Master's degree		
1960	7,159	1,765	3,387	12,311
1965	12,260	4,270	5,030	21,560
1970	21,740	9,080	7,730	38,550
1975	31,100	14,640	9,770	55,510
		Doctor's degree		
1960	786	303	1,838	2,927
1965	1,880	650	2,580	5,110
1970	3,250	1,080	3,560	7,890
1975	5,680	1,840	5,140	12,660

The potential for large increases in the number of graduate degrees awarded in the 1980's can be seen in the projections for bachelor's degree recipients. A total of 76,410 students received bachelor's degrees in EMP fields last year, or about 11,000 more than in 1960. But the numbers are expected to increase to almost 120,000 a year by 1970 and to about 148,000 by 1975. These EMP graduates would represent about 16 percent of all bachelor's degree recipients in 1975—as against the 14 percent who received their bachelor's degree last year in EMP fields.

The Gilliland panel's goals have not been revised and still represent as much of a position as the administration has. The goals were discussed during hearings on the National Science Foundation (NSF) last summer by the House Science and Astronautics Committee's subcommittee on science research and development. Leland J. Haworth, director of NSF, said, "We are in a position where the proposed goals are now possible of attainment, thanks to the hitherto unprecedented support provided for these fields in the late 1950's and early 1960's." He added that a "substantial further effort" by all parties supporting students and graduate education will be necessary.

Statistics assembled by the White House Office of Science and Technology show clearly that the greatest federal boost for graduate education in EMP fields has come since the Gilliland report, and, to a considerable extent, has been in response to it.

In fiscal 1963, when the report was issued, 4865 graduate students in EMP fields were receiving aid under federal fellowships. Each fiscal year thereafter the number of students supported by federal fellowships or training grants has increased: to 8099 in 1964; 11,217 in 1965; and 13,720 in 1966 (estimated). Even so, the numbers supported have fallen far short of the recommendations of the Gilliland panel. The panel would have had the government provide support (exclusive of research assistantships) for 20,000 in 1964, 22,200 in 1965, and 24,200 in 1966.

Eric A. Walker, chairman of the National Science Board, told the House subcommittee that NSF, while trying to meet its responsibilities, has not received the appropriations necessary to support EMP students in the numbers which many educators believe are required. He observed that even though NSF has given special attention to engineering, a field in which doctorates only now are becoming common, the effort has been inadequate. In fiscal 1964, about 1200 NSF traineeships in engineering were established, and 1800 of the 2800 EMP traineeships added in fiscal 1965 were in engineering. "Unfortunately, the 1800 allowed about 900 of the original 1200 engineering trainees to continue into the second year, and the number of new first-year traineeships was reduced from 1200 to 700," Walker said. "This produced considerable unhappiness among engineering

educators. However, the problem is one that only money can solve."

Federal support for graduate students has continued to increase, though not by great leaps. For example, during the 1966–67 academic year, 4150 students—most of them in EMP fields—will be supported by NSF traineeships. The number supported by the traineeships will rise to 5100 in 1967–68, provided Congress approves the new NSF budget.

Universities have submitted a new round of proposals for traineeships, and NSF is now studying them to determine the number needed beyond 1967–68. The traineeships program, now in its third year, is a new departure for NSF, which has emphasized the awarding of fellowships to the most talented students. NIH, on the other hand, has long followed a policy of supporting large numbers of qualified candidates for graduate degrees through training grants, as well as supporting the exceptionally able by fellowships.

In the next academic year an additional 6000 graduate students will be supported by fellowships awarded under the Office of Education's National Defense Education Act. Thirty-four percent of the students will be in the physical sciences and engineering. NDEA fellowship awards, of which there were only 3000 for the current academic year, will be increased to 7500 for the 1967–68 if Congress provides money for the number already authorized.

John W. Ashton, director of the Office of Education's graduate programs, believes that by the academic year 1969–70 the number of qualified graduate students will be large enough to justify increasing the NDEA fellowship awards to 10,000 a year. Ashton also would like to see special 1-year fellowships provided for students who have left graduate school after completing all their doctoral-degree requirements except their dissertation.

The Office of Education (OE) is considering a proposal to lengthen the fellowships from the present 3 years to 4 or 5 years, the period needed by most students to complete Ph.D. requirements. The wisdom of this is still being debated, however. "I rather like the idea of the universities sharing in the responsibility of supporting graduate students," Ashton said. "So I'm afraid my attitude [toward the proposal for 4- or 5-year fellowships] is somewhat equivocal."

Ashton noted that OE already has abandoned its old policy of requiring that a fellowship run through three consecutive years. Now the fellowship can be spread over 5 years, with the student and his university arranging for his support for 2 years.

Several other agencies, such as the Atomic Energy Commission and the Department of Health, Education, and Welfare (as distinct from OE), are supporting students in EMP fields. However, the only large fellowship program other than those conducted by NSF and OE is that sponsored by the National Aeronautics and Space Administration (NASA). Some 3100 graduate students are now studying under NASA fellowships at 152 colleges and universities. An additional 1335 fellowships, for study in space-related fields (including the life sciences), will have been awarded by next fall. The number of NASA fellowship awards is expected to decline somewhat in 1967–68.

Federal support for graduate study may become critical to the continued growth of student enrollments. The surprising growth in the number of degree candidates in EMP fields makes it clear that support from nonfederal sources has been more important than the Gilliland panel realized. But the Office of Science and Technology believes that nonfederal support will not increase rapidly beyond current levels. Moreover, OST observes that, even now, many first-year students must depend heavily upon research assistantships instead of concentrating their energies on meeting degree requirements. The result is that their graduate studies are unduly prolonged.

In addition to recommending greater student support, the Gilliland panel recommended increasing "cost of education allowances" for institutions. These allowances, of $2500 per student under NSF and NDEA programs, are supposed to fill the gap between the student's fees and the true cost of his education. The panel, using OE figures, said that the allowance should be $3380 per student in mathematics and physical sciences and $4020 per student in engineering. This recommendation has not resulted in favorable action, however, and the allowances remain unchanged at $2500.

Progress has been made toward fulfillment of the panel's recommendations for federal support for the development of graduate facilities used in EMP fields. The federal share of the program proposed by the panel would have been $125 million a year for fiscal 1964 through 1966. Federal funds actually spent for this purpose amounted to $42 million for 1964 and $69 million for 1965. Last summer OST estimated that another $76 million would be spent during fiscal 1966.

Science development grants by NSF in fiscal 1965 totaled about $27.4 million, with all but a few million going into EMP fields. Another $40 million in development grants are expected to be made this year, and for fiscal 1967 NSF is asking Congress for $45 million which would be awarded in such grants. Graduate facilities grants in EMP fields under the Higher Education Facilities Act in fiscal 1965 totaled about $16 million (*Science*, 26 November 1965). These programs are likely to continue as long as important needs in graduate education are unmet.

The goals set by the Gilliland panel for the production of well-trained EMP personnel reflected not so much an estimate of student and market demands as an estimate of what was attainable. The panel had to bear in mind the limited capacity of graduate programs to absorb rising enrollments. Many institutions already are having to struggle to meet the new demands on their programs in EMP fields. For example, one Midwestern university plans to add 25 new members to its mathematics department over the next several years, and is wondering where it is going to find them.

As enrollment pressures continue to mount, the problem of reconciling the accommodation of large numbers of students with the need to maintain high program quality will grow increasingly serious. In time, the focus of concern may have to shift from increasing the graduate school's capacity to absorb and support more students who are "qualified" in terms of today's criteria to establishing increasingly selective admission standards.—LUTHER J. CARTER

Meeting Notes

Travel grants for a limited number of participants in the **Pacific science congress** are available through the National Academy of Sciences–National Research Council. Funds are being provided by several government agencies for tourist-class air travel to the meetings, which are scheduled 22 August to 10 Sepetmber. Application deadline: *21 February*. (Pacific Science Board, Office of the Foreign Secretary, NAS–NRC, 2101 Constitution Avenue NW, Washington, D.C. 20418)