V. SCIENCE EQUIPMENT FOR UNDERGRADUATES: PROGRAMS AND OPTIONS

One Federal program is aimed specifically at providing grants for instructional science equipment at the undergraduate level. This is the College Science Instrumentation Program (CSIP) administered by the National Science Foundation. CSIP received an appropriation of $5 million in fiscal year 1985, its first year of operation. The same level of funding was appropriated for fiscal year 1986. The proposed level of funding for fiscal year 1987 is $7.5 million. CSIP, which was initiated by Congress, is similar to an earlier program, the Instructional Scientific Equipment Program (ISEP), which was in existence for 20 years until it was eliminated in 1981.*

Only those 4-year colleges without graduate programs are eligible for CSIP grants, which must be matched on a '50-50' basis by other sources. ISEP was open to universities and 2-year colleges as well. In 1985, CSIP funded about 17 percent of the 1,348 proposals submitted.[44] This funding rate is similar to the 17.5 percent of the proposals funded by ISEP in 1981, the last year of that program's operation.

The number of proposals submitted for CSIP grants is surprisingly similar to the level submitted to its predecessor program in 1981 (1,348 for CSIP compared to 1,399 for ISEP). While this suggests that the need for equipment has remained fairly constant over the years, it is important to remember that a smaller number of schools are eligible for CSIP than its predecessor program. Also, some educational associations suggest,[45] the number of proposals can be expected to be greater in subsequent years as this new, revived program becomes better known in the academic community.

While CSIP is the only Federal program aimed specifically at undergraduate

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* Between 1981 and 1984, the National Science Foundation (NSF) had no equipment grant program for undergraduate science equipment. The Instructional Scientific Equipment Program (ISEP) was one of many education programs ended when the NSF Science and Engineering Education branch was closed in 1981.

44. Chemical and Engineering News, "NSF Sums Up First Year of Instrumentation Program/' op. cit, p. 25.

45. Ida Wallace, Independent Colleges Office, Washington, DC, interview, 1985.

equipment, other NSF grant programs may provide equipment to undergraduates institution as part of research grants. According to the Office of Management and Budget,[46] NSF spent a total of $88 million on undergraduate equipment between 1982 and 1985, compared to $100 million between 1952 and 1982. The totals include CSIP grants, support for undergraduate faculty research proposals submitted directly to NSF's disciplinary research programs, and proposals submitted through the Research in Undergraduate Institutions program.

Most of the members of the academic and industrial community interviewed by OTA agreed that it would take a combined effort by the Federal and state governments, academia, and industry to update the laboratory equipment that is used to educate undergraduate science and engineering majors.

The undergraduate institutions and the Reagan Administration differ vigorously on the role that the Federal Government should play in helping to bring equipment up-to-date. The Administration considers undergraduate education to be a State and institutional responsibility, not a Federal one. Colleges answer that: l) since the 1950s, NSF has had numerous programs aimed at undergraduate science; and 2) the quality of undergraduates eventually affects the research done by the Nation's scientists. The Federal Government, in response to complaints by schools, points to industry donations as a source of additional support. But both academics and industry representatives say that these donations are relatively small compared to the scope of the equipment problem.

In the belief that there is a clear national interest in helping the Nation's scientists to advance the frontiers of research, many Administrations have placed the majority of Federal science support into research and graduate schools. This policy assumes that undergraduates who seek science careers on the frontiers of their field will somehow manage until they reach graduate schools, where the funding for science is concentrated. Undergraduate education has been seen as a State, local, and private

46. Loweth, op. cit.

responsibility. Undergraduate institutions must weigh the increasing cost of equipment to prepare students for graduate work or employment in science and engineering against declining enrollment and budgetary pressures.

John Wright of the University of Alabama, in his testimony on the University Research Facilities Revitalization Act of 1985, before the House Committee on Science and Technology, Subcommittee on Science, Research, and Technology, recognized the importance of the 4-year college in educating science students. He noted that these students go on, in high proportions, to succeed in post-graduate work, earn doctorates, and become research faculty at leading institutions.[38] This point is of primary importance to a group of 48 prestigious liberal arts colleges, the self-proclaimed research colleges, who contend that they contribute to the Nation's scientific base by producing a disproportionate number of the Nation's future researchers.[39] This group of colleges is vocal in their demand that the Federal Government support their research efforts. In some disciplines, such as engineering, the majority of students enter the profession with undergraduate degrees only. In other fields, which require graduate work as a professional entry card, the undergraduate experience remains critical for interesting students in pursuing a research career.

Where does the Federal Government draw the line on its responsibility to support education? Can the Federal Government mobilize sufficient funds to support an expanded field of educational institutions? Considering that by one study's estimate, over $2 billion would be needed just to bring everything in engineering colleges up-to-date, the needs in all scientific fields for all colleges and undergraduate departments of universities could be staggering.[40] To quote one veteran budget official, 'Part of the

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38. Statement by John Wright on the University Research Facilities Revitalization Act of 1985 before the House Committee on Science and Technology, Subcommittee on Science, Research and Technology, Oct. 22, 1985.

39. Testimony of S. Frederick Starr, President, oberlin College, before the Task Committee on Undergraduate Science and Engineering Education, the National Science Board, Sept. 26, 1985, pp. 7and 10.

40. National Society of Professional Engineers, <u>Engineering Education Problems: The</u>

reason for a policy against it [supporting undergraduate education] is so you don't have to face up to how much you have to do."[41] Many of the individuals interviewed OTA asserted, however, that incremental increases produce proportionate improvements in the quality of instruction.

How then can science and engineering departments finance their equipment purchases? The solution *most* commonly proposed is a combination of Federal, State, industrial, and academic support for new equipment. Since all of these sources have their own limitations and other competitors for funds, another possibility is that the increasingly expensive costs of scientific and engineering equipment will force a reduction in the number of schools or departments that teach equipment-intensive fields. The tendency of some companies to favor applicants with graduate degrees suggests that graduate schools, not undergraduate departments, will continue to be the principal location of newer technological equipment in the future. The extent to which purchases of graduate research equipment influences the needs for undergraduate instructional equipment is not clear.

Internships, through which students have a chance to use modern equipment at nearby industries, are often proposed as a solution for universities and colleges unable to replicate modern industrial equipment. 'Cooperative" programs, where students work for one or two semesters in an industrial or government laboratory, are offered for credit by many engineering and chemistry departments.

While some in academia look upon cooperative programs as an excellent supplement to the student's education in the use of equipment,[42] others are emphatic that such programs should not replace the university's obligation to stay up-to-date.[43] Objections raised to such programs include difficulties for schools not located near appropriate

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Laboratory Equipment Factor (Washington, DC: September 1982), p. 6.
41. Hugh Loweth, Office of Management and Budget, Washington, DC, interview, 1985.
42. Thaddeaus C. Ichniowski, Illinois State University, Normal, IL, interview, 1985.
43. George Dieter, Universityof Maryland, College of Engineering, College Park, MD, interview, 1985.

industries and the issue of academic independence. “The university has to provide the opportunity to pursue knowledge for the sake of knowledge, ” says Rita Colwell, Vice President for Academic Affairs, University of Maryland. “If we turn into an apprentice shop for industry,” Colwell objects, “the university will not be serving that primary goal. ”

Because there is no consensus about the effects of the undergraduate equipment problem on the quality of education on scientists and engineers, there is no consensus as to the best way to proceed. As mentioned in this brief paper, options range from new Federal direct assistance to increased cooperation with industry, from active decisions as to the number and type of institutions that meet some ‘national need” criteria to simply allowing individual institutions to manage as best they can, and from defining the undergraduate years as a strictly State and local responsibility to specifying a commitment to this portion of technical training. Until these questions are resolved, it is unlikely that there will be agreement on new policy steps.