mean selectivity score using the student as the unit of analysis (52.5) was slightly higher than the mean selectivity score using the institution as the unit of analysis (48.8) (Table 2). Student means on other institutional characteristics, however, tended to be very close to the institutional means.

12. It is always possible, of course, that the residual scores on the Graduate Record Examination were not independent of certain potentially biasing student input characteristics that were inadvertently left out of our analysis. The principal objective in this and similar "natural experiments" is to measure and statistically control as many potentially biasing student input characteristics as possible.
13. In terms of classical test theory, our method of analysis would not produce residual scores on the dependent variable which are independent of the student's "true" input scores, as long as there are random errors in the measurement of the input variables. Such errors have the effect of flattening the slope of the observed regression of the dependent variable on the independent variables. The appropriate procedure to adjust for this source of bias is to compute the intercorrelations of the variables using the variances of the "true" input scores rather than the variances in the observed input scores. We were not able to conduct our entire analysis using these "true" variances, because of the difficulty in estimating the reliability (that is, the ratio between "true" and observed variances) of the many qualitative input variables (for example, the student's initial field of study). However, the availability of reliability estimates for our key input variables—the National Merit Scholarship Qualifying Test scores—enabled us to run two additional analyses: one using the observed variances in these scores, and the other using their estimated true variances. In both analyses the scores were first entered into regression after which we examined the partial correlations between achievement on the Graduate Record Examination and the various measures of institutional quality. Using the true rather than the observed variances altered the partial correlations only slightly, but in every instance the shifts were in the negative direction (that is, contrary to the two hypotheses).
14. A. W. Astin and R. J. Panos, *The Educational and Vocational Development of American College Students* (American Council on Education, Washington, D.C., in press).
15. Because of the relatively small numbers of students at each institution, it was not possible to compute reliable estimates of the mean residual gain (or loss) in points on the Graduate Record Examination for individual institutions. Nevertheless, it should be recognized that there may be some institutions where the absolute "value added," in terms of points on the Graduate Record Examination above or below what would be expected from the students' input characteristics, is considerable. The point to keep in mind is that the results of the current study indicate that such institutions are no more likely to be found among the highly affluent than among the least affluent institutions.
16. R. C. Nichols, *J. Educ. Psychol.* **55**, 45 (1964); A. W. Astin, unpublished manuscript.

17. This study was supported in part by grant GR-22 from the National Science Foundation to the American Council on Education. I thank G. V. Lannholm of the Educational Testing Service for his assistance in obtaining the students' scores on the area tests of the Graduate Record Examinations; C. Sell for assistance in data processing; and R. J. Panos for his help in many phases of this project.

Medical Schools: Federal Funds Increase, So Do Budget Ills

Medical schools straddle two sectors of the economy in which costs are rising giddily—higher education and health services. Many a medical school is living beyond its income and relying on emergency fund raising or timely benefactions to make up the deficit. There is even dark talk of some financially weaker schools losing accreditation.

Federal research funds have provided the biggest growth factor in medical school budgets since World War II, but it was not until 5 years ago that federal money for medical-school teaching programs became available explicitly and in significant quantities. Just how important these funds have become to the medical schools can be judged from the cries of anguish which arose when the administration's spring economy edict resulted in a drastic shortening of the list of medical schools scheduled to receive funds under a "special improvement grants" program specifically intended to help schools overcome weaknesses which give them accreditation problems.

More than 50 expectant medical schools got the bad news that their projects, most designed to strengthen faculty or improve teaching resources, could not be funded after all. About $20 million had been available originally for the program; this was finally cut to $10 million. Grants, mostly in the $200,000 to $300,000 range, went to 23 medical schools and two schools of osteopathic medicine judged to be in greatest need. The Bureau of Health Manpower, formerly under the Public Health Service but shifted to the administrative fief of the National Institutes of Health in a recent reorganization, administers the grants program and has been taking a buffeting from its disappointed medical-school clients. The program has been on the books for 3 years, but this was the first year that funds had been appropriated to finance it, and the disappointment at having the grants snatched away seems to have been sharpened by the fact that, financially, so many schools are living dangerously this year.

The bureau also administers the bigger "basic improvement grants" program which this year pumped $32 million into medical schools and other health-professions schools. Funds under this program are distributed by a formula which takes into account the number of full-time students in each school. The special grants are awarded on a competitive basis, and administrators at some schools told *Science* they apparently failed to describe their straits vividly enough and now feel that grants went to some schools whose plight was less desperate. The section that administers the grants says that an effort is being made to acquaint its clients with what is expected on the applications, and also indicates that more visits to applicant schools will be made, to gather on-the-spot information.

Direct federal support of medical-school teaching programs dates back to 1963, when the Health Professions Assistance Act became law. It had the distinction of being the solitary major legislative innovation proposed by President Kennedy in the field of education to be passed before his assassination. The act originally authorized matching grants for the construction of teaching facilities, and so far it has provided $365 million for the building, expansion, and renovation of teaching facilities for medical and dental schools and other health-professions schools.

The law was amended in 1965 to provide the improvement grants programs and also a loan program for students of medicine, dentistry, osteopathy, and optometry. Students in podiatry, pharmacy, and veterinary medicine have since been made eligible.

There was a breakthrough for federal aid to health-professions teaching programs, and the situation now is dra-

matically different from the pre-1963 era, when the motto for Congress might well have been millions for research but nothing for medical school teaching.

Just before Congress recessed, for example, the Senate and House passed the Health Manpower Bill, which combines extensions and revisions of the Health Professions Assistance Act and four other major pieces of legislation.*

It has been estimated that 40 federal laws now affect medical schools, but the new legislation has brought not only new funds and new opportunities to the medical schools but also added responsibilities and fresh financial strains.

Few medical schools have large endowments, and, as medical school operating budgets have expanded, the problems of financing have escalated. Congress has been a demanding patron. It has hewn to a matching-funds philosophy in providing for construction of both research and teaching facilities, although this year Congress increased the share the federal government may provide from half to two-thirds in certain cases. Congressional intent in providing the teaching facilities was to encourage an increase in medical school enrollment. Recipient schools have often incurred costs beyond those covered by federal funds.

New laws left at the doors of medical schools the responsibility for staffing federally supported community health programs and for training nurses, medical technologists and therapists, and other health service personnel.

Medical school fortunes are usually intertwined, officially or otherwise, with medical centers, which are increasingly expensive and complex to run. When salaries of interns and residents go up, for example, the salaries of medical school instructors also rise. Medical school and hospital budgets are often kept separate, but the interaction inevitably affects medical school economics.

One serious problem which insiders privately admit is fairly general is the ossified state of medical school administration. The oligarchical, post-Flexner government of the medical schools has lived on into a period when it can be disastrously unsuitable.

University-connected medical schools face difficulties on another flank. Many university administrations which in the past were willing to scrape up funds to tide their medical schools over, now declare themselves unable to do so any longer. Medical schools related to private universities are, in a number of cases, seeking statutory divorces and courting public authorities with a view to finding a new meal ticket.

The private medical schools—which number about half the total of 100—

* Included are the Nurse Training Act of 1964, the Allied Health Professions Personnel Training Act of 1966, the Health Research Facilities Act of 1956, and the section of the Public Health Service Act on public health traineeships.

FDA Cans Irradiated Bacon

The Food and Drug Administration (FDA) has decided to rescind its approval of irradiated canned bacon, which it had originally granted in 1963. Daniel Banes, associate FDA commissioner for science, told the Joint Committee on Atomic Energy on 30 July that new data on irradiated bacon had shown "suggestions of adverse effects." He produced charts which showed that studies of feeding irradiated bacon to rats indicated deleterious effects on the reproductive process, "apparent production of antinutrient factors," and "apparent effects on mortality, body weight gain, and red blood cell count and hemoglobin."

Irradiated bacon has not been produced for the commercial market. Two private companies did produce 15 tons of it in 1966, but that bacon—like irradiated bacon produced by the Army—was used by the military only, for tests and experiments; it was not part of the regular military diet.

FDA decided to reexamine the data for irradiated bacon after turning down a Department of the Army petition for irradiated canned ham in mid-April (*Science*, 12 July). Since FDA scientists found "suggestions of adverse effects" in data received in support of the ham petition, FDA decided to ask for more data for bacon, and then found the deleterious effects that Banes enumerated.

Banes and J. K. Kirk, associate FDA commissioner for compliance, who also testified at the 30 July hearings, were criticized by several committee members, especially Representative Melvin Price of Illinois, chairman of the subcommittee for research, development, and radiation. Price charged that FDA was digging up data from feeding studies conducted several years ago, and was basing its claims of adverse effects on those data.

Edward S. Josephson, associate director of food radiation at the Army's Natick (Massachusetts) laboratories, wore a pained smile after the hearings. "We could fight this for ten years," he told *Science*, "but then we still might lose. Right now we have to get approval for one meat. It's simpler to get a regulation than to fight this." Josephson said that the Army is working closely with FDA officials to set up protocols for new 2-year feeding studies on irradiated ham. He said that new feeding studies on bacon were "not on our immediate schedule," but added that the Army might take up the bacon case later.

Commercial production of irradiated foods must wait until the Army and FDA work out their disagreement. Work on a commercial plant, Irradiated Foods, Inc., which was to produce irradiated meats on a large scale, was postponed after rejection of the ham petition. At this point, other interested commercial meat producers will continue to wait for FDA to approve an Army petition. Research and tests are too costly for private companies to undertake independently.

FDA is unmoved by the advantages claimed for irradiated foods—longer shelf life, safety from dangerous insects and microorganisms, no need for refrigeration. It simply wants to make sure that the products are safe, and this, it says, has not been convincingly demonstrated. Until the Army and FDA come to some kind of agreement over what constitutes acceptable data, what is an acceptable display of safety, and what are acceptable feeding studies, irradiated foods will face continued difficulty.—ANDREW JAMISON

NEWS IN BRIEF

• **DEEP-SEA DRILLING**: Drilling should begin in the next few weeks off the Texas coast in the Gulf of Mexico in the National Science Foundation–sponsored Deep-Sea Drilling Project (*Science,* 28 June). Plans are to drill more than 60 holes during the next 18 months in the Atlantic and Pacific oceans in order to study the sedimentary layers of the ocean floor. Costing some $12.6 million, the project is managed by the Scripps Institution of Oceanography at the University of California, San Diego, for the Joint Oceanographic Institution's Deep Earth Sampling group, a five-university consortium set up in 1964. The drilling from a specially built ship, the *Glomar Challenger,* will go to depths of about 20,000 feet. The project resembles the so-called intermediate phase of the canceled Project Mohole, and the top layer of the oceanic crust will be penetrated. Drilling will not reach the mantle, which was the ultimate goal of Mohole.

• **McCARTHY ADVISERS:** Two former presidential science advisers have been named to Senator Eugene McCarthy's new foreign policy advisory panel; they are George Kistiakowski, Harvard professor and former science adviser to President Eisenhower, and Jerome Wiesner, provost of Massachusetts Institute of Technology and former science adviser to President Kennedy.

• **DDT REGULATIONS:** The amount of DDT allowed to remain on food crops going to market will be reduced substantially after 1 January 1969 by the Federal Drug Administration (FDA). The FDA plans to lower tolerances for DDT, one of the most widely used insecticides in agriculture, from present levels to significantly lower levels, in some cases by more than 50 percent; the change will affect many varieties of fruits and vegetables which are inspected by the Agriculture Department. Products not within the tolerance level will be seized or destroyed. More than one half of all fruits and vegetables sold commercially will be affected.

• **AIR TRANSPORT REPORT:** In the first report of its Aeronautics and Space Engineering Board, the National Academy of Engineering has urged that the National Aeronautics and Space Administration (NASA) should be given a major role in conducting civil aeronautics research and development. The board recommended that a comprehensive study of the whole air transportation system be made and priorities set for research and development. The report, which also recommended that leadership in carrying out comprehensive studies be provided by the Transportation Department and the Federal Aviation Administration, was financed by NASA. *Civil Aviation Research and Development: An Assessment of Federal Government Involvement,* is available at $4 from the Aeronautics and Space Engineering Board, National Academy of Engineering, 2101 Constitution Avenue, Washington, D.C.

• **SHANNON APPOINTMENT:** James A. Shannon, retiring director of the National Institutes of Health, has been appointed a special adviser to the President and to the National Research Council of the National Academy of Sciences (NAS) on matters relating to programs in both science and medicine. Shannon will take up his post as a high-level staff member of NAS after his 1 September retirement from NIH.

• **RIVERSIDE FIRST:** A new college that will stress a program relationship between basic research in the biological sciences and its application to agriculture will be the first of several interdisciplinary colleges proposed for the Riverside campus of the University of California. The close connection between the new college and the large research program of the Agricultural Experiment Station will provide coordinated research experiences for both graduate and undergraduate students.

• **NEW PUBLICATIONS:** *Exporting Technical Education: A Survey and Case Study of Foreign Professionals with U.S. Graduate Degrees,* a statistical study on the brain drain, may be obtained for $4.50 from the Publications Division, Institute of International Education, 809 United Nations Plaza, New York 10017.

The Line Islands Experimental Data Catalogue, which contains meteorologic data from the Equatorial Trough Zone, may be obtained from the Publications Department, National Center for Atmospheric Research, Boulder, Colorado.

have special problems. A few private schools like Harvard and Columbia are heavily endowed and still head the list of the "have" schools. It is the poorly endowed private schools lacking state support which are in deepest difficulty. It is from among these schools, perhaps 15 or 20 of them, that most of those on the disaccreditation danger list are drawn.

Medical school accreditation is controlled by a liaison committee made up of representatives of the Association of American Medical Colleges and the American Medical Association. Until now, schools in danger of losing accreditation have been discreetly advised of their deficiencies and put on "confidential probation." The committee has decided to discontinue this practice, and from now on those in peril will, presumably, be put on public notice. In practical terms, disaccreditation of a medical school appears about as unlikely as foreclosure of a mortgage on a church. One informant close to the accreditation authorities noted that a medical school in imminent danger of losing accreditation would be so close to internal collapse that disaccreditation would be academic. He estimated that two or three schools, unless their fortunes improve, could be in real jeopardy.

New medical schools—and there are some 17 now in operation—also have unique problems. They have had to recruit whole new faculties. Most of them are state institutions, and some legislatures have provided start-up funds which enabled these schools to be free-wheeling competitors for talent. State support is now being less freely given. At the same time, federal research support has leveled off, and the new schools which counted on a continued expansion of research funds are now facing a period in which, it appears, researchers in established institutions may have the advantage in getting the funds available.

It is ironic that the squeeze on federal funds comes at a time when Congress is taking a sympathetic interest in building health manpower. The view of the average senator or congressman may be parochial. He is probably aware of a shortage of G.P.'s and nurses in his constituency. He may be disturbed by the reliance of U.S. medical service on the flow of foreign-trained physicians. And he probably hears complaints about the difficulty of gaining admission to medical school. The legislators' reaction, however, has been to

vote funds for research on a steeply rising curve for a decade and, more recently, to pass a variety of bills underwriting education in the health professions.

There are signs that this congressional interest could turn critical. On 1 August, when the Health Manpower bill was passed, the House also acted favorably on a bill authorizing the establishment of a National Eye Institute as part of NIH. Representative William T. Cahill (R–N.J.) used the occasion to elaborate a charge that federal support of medical research has had an adverse effect on the production of medical manpower. Cahill is a lawyer and a member of the Judiciary Committee, and his concern seems to have been triggered partly by his committee's findings on the dependence of U.S. medicine on foreign-trained physicians. Cahill developed the theme that "research has diverted physicians away from the patient and the hospital and into the laboratory." He traced the rise in medical research funds in recent years. And he told how he had found that the University of Pennsylvania medical school — the school closest to his South Jersey constituency—had, despite a flow of research and construction grants, produced slightly fewer medical graduates in 1967 than it did 10 years earlier.

Cahill also found ammunition in the investigations of the House Government Operations Committee's intergovernmental relations subcommittee, chaired by Representative L. H. Fountain (D–N.C.). Fountain has been a persistent critic of NIH administrative practices, and in its last report (*Science*, 3 November 1967) his committee also blamed research grants for "excessive diversion" of professional personnel from teaching and medical practice to federally supported research.

These allusions drew a pointed rebuttal from Representative Melvin R. Laird (R–Wis.), a dominant minority member of the Appropriations subcommittee which oversees NIH funds. As part of his endorsement of NIH management, Laird read into the record testimony presented before his subcommittee by retiring NIH director James Shannon. Fountain responded sharply later in the debate and also inserted a lengthy recapitulation of his subcommittee's findings in the *Congressional Record*.

This byplay revealed a certain tension between the Fountain subcommittee, on the one hand, and the Appropriations and Commerce subcommittees which handle health education legislation, on the other. And it is known that Fountain would be inclined to investigate the effects of research funds on medical teaching but feels that, in present circumstances, insiders are not disposed to speak frankly on the subject.

It should be noted that Cahill kindled no revolt in the House. He himself voted for the Health Manpower bill when it rolled through and was apparently speaking mainly for the record.

Medical research is not in conspicuous trouble in Congress, but its halcyon days are probably past. With the Fogarty-Hill alliance gone from Capitol Hill and Shannon retiring, the fortunes of medical research will be in the hands of new and untried management. The legislation explosion in the health education field has given these programs greater visibility and much more money. (The 2-year price tag on the Health Manpower Act topped $1 billion.) With the squeeze on funds affecting all civil spending, it is reasonable to expect that, in the health sector, some competition for funds will evolve between research and teaching.—JOHN WALSH

Space Science Board: Advisers Cool on Sending Men to Planets

Looking beyond the moon, the National Aeronautics and Space Administration is no longer, in this tight-budget era, actively considering manned voyages to Mars. Its budget now down by more than a billion dollars from a year ago, NASA will, at most, carry out a modest series of unmanned planetary flights in the 1970's. If its budgetary prospects should later improve, the agency's visions of manned planetary expeditions may well return. Yet much of the support earlier given such aspirations by key scientists seems to be slipping away.

Until now, many of the scientists closest to the space program—especially those serving on key official advisory bodies—have held that, ultimately, men would have to visit the planets if scientific exploration of those bodies was to be fully productive. But a new report just released by the National Academy of Science's Space Science Board (SSB) says that automated spacecraft should be able to do the job.

Prepared by an SSB study group headed by Gordon J. F. MacDonald (vice-president for research of the Institute for Defense Analyses), the report sets forth priorities for a program of planetary exploration for the period 1968–75. It alludes to the fact that SSB and the space science and technology panels of the President's Science Advisory Committee (PSAC) have, in the past, recommended various programs intended to give the United States the option of eventually undertaking manned planetary flight. It then adds:

> These [recommended programs] include biomedical programs exposing man to space conditions for long periods (100 to 200 days) in earth orbit to determine whether he is qualified to undertake planetary missions (these missions involve round trips of about 700 days). Such biomedical qualification requires the development of special vehicles since neither the present Manned Orbiting Laboratory [an Air Force project] nor Apollo could easily be adapted for long-term missions; needless to say, these programs involve substantial funding.
>
> We were unable to identify a need in planetary exploration, in the foreseeable future, for the unique abilities of man. . . . In the face of a limited space budget, we favor reallocation to the unmanned exploration of the planets of those resources directed to efforts preparatory to a manned planetary program. The rapid development of technology suggests that full automated systems of substantial complexity will be available for planetary exploration and that this technology should be capable of answering the major scientific questions that we can now pose about the planets.