berger will be the assistant secretary for health, formerly the assistant secretary for health and scientific affairs. For the last 18 months, the post has been held by DuVal, who took a leave from his job as dean of the new College of Medicine in the University of Arizona at Tucson. DuVal has resigned according to plan and will return to Tucson as vice president of health affairs. From the beginning, DuVal said he intended to stay in Washington only long enough to reorganize the office of assistant secretary to give it some substance (*Science*, 15 September). He believes he has done that and so, in spite of what he calls "severe pressures" to have him stay, he is going home.

Under a recently accomplished reorganization, the assistant secretary for health will have real responsibility for coordinating the health-related functions of HEW, largely through his direction of the Public Health Service: the NIH, the Health Services and Mental Health Administration (HSMHA), and the Food and Drug Administration (FDA).

When DuVal first came to Washington, those three agencies had directors who had been around a while and who had, and wished to keep, a reasonably direct line to the secretary of HEW. DuVal encountered some opposition when he tried to insert himself between those men and a secretary who did have some knowledge of and interest in health. Now, he predicts, with the structure and the players changed, things will be different. The new assistant secretary, he speculates, may have real power.

In addition to a new director of NIH, there will also be a new chief at HSMHA. Vernon Wilson resigned from that job before his pro forma resignation could be picked up, apparently because he had reason to believe it would be. Wilson will return to the University of Missouri.

The only one left of the three is Charles C. Edwards, head of the FDA. Edwards is a Republican and a management type who had been at Booz, Allen and Hamilton, the Chicago-based consulting firm, before taking on the FDA. Generally speaking, Washington officials think he has turned in a creditable performance in the way he handles an almost impossible job. Speculation is that Edwards will either stay where he is or, possibly, move into DuVal's job.

Other people on the out list include Jesse Steinfeld, the surgeon general, whose job has been so downgraded that it has virtually disappeared, and former assistant secretary Roger O. Egeberg, who has been at HEW as a special assistant in charge of international relations since leaving the assistant secretaryship. At this writing, Steinfeld is formally out. Egeberg's resignation has not been picked up, but it is expected to be.

People are waiting to see what will happen at the Veterans Administration (VA), which has a greater involvement in the total health picture than is often appreciated, and at the Social Security Administration. Until further notice, Donald E. Johnson runs the VA, with Marc J. Musser as medical director. Robert Ball is chief of social security.

The departures from the top levels of government that have occurred or are anticipated represent one of the biggest turnovers of health officials that anyone can remember. The inclination to look for some Machiavellian scheme behind it all is inescapable. However, a number of observers believe that what is going on is really quite straightforward. The President, they point out, said he intended to streamline the government. Quite possibly, he intends to do so by making a fairly clean sweep of people in the upper ranks and replacing them with individuals chosen primarily for their talents as managers. That is the way it appears now.—BARBARA J. CULLITON

NSF: Engineers' Policy Group Urges More Software for RANN

The week of the final Apollo mission launch from Cape Kennedy, touching off another round of debate in the press over what, if anything, the United States has to show for its investment in space, the National Academy of Engineering's Committee on Public Engineering Policy (COPEP) released a report offering some new and refreshing views on how science might redirect itself in the quest for earthly relevance.

In the first of what will be a trio of reports due in the next year concerning the National Science Foundation's (NSF) most politically sensitive program, Research Applied to National Needs (RANN), the engineers' group told NSF in no uncertain terms that RANN must get involved in the nitty-gritty of institutional malfunctioning and reform as the key to answering national needs. RANN must, summarized COPEP chairman Edward Wenk, Jr., in a cover letter to the first report, find ways to improve the "effectiveness of our largely public and quasi public systems for delivering human and governmental services" in health, education, and so forth. Moreover, instead of just asking scientists what they might dream up as useful for the nation, RANN should start dealing with what COPEP termed the "users" of technologies, and ask them what they need. RANN must also seek far more institutional independence. RANN should "tread more boldly into problem areas where, on the surface, one might conclude that other agencies of government have major interest and jurisdiction."

COPEP was chosen to make the $280,000 review last spring because of two previous COPEP reports on applied research which, say RANN managers, formed much of the intellectual basis for starting the program. However, since only a few officials at NSF have had a chance to read the 450-page report, the issue of how much the foundation will implement COPEP's recommendations is, for the moment, premature.

The COPEP report urges RANN, which already serves as an applied research arm of NSF, to become even more so. Principally organized by Wenk; Raymond Bauer, chairman of the RANN advisory board and professor of business administration at Harvard University; and Micah H. Naftalin, executive director of COPEP, the interim

report sets forth the notion of research oriented around "technological delivery systems," which are the "complex processes by which knowledge in natural and social sciences is deliberately applied to achieve desired outputs of consumer amenities and social values." A technological delivery system "is more than hardware," in COPEP's summary definition. It "involves an ensemble of practices and institutions" which "blend inputs of technical information, capital, natural resources, and manpower with inputs of our society's value preferences." Institutions which thus "blend" into a given system include universities; profit and nonprofit research organizations; "political components" that "interpret value preferences through incentives or regulation"; federal, state, and local governments; and "a spectrum of private industry components."

In other words, the COPEP report argues that the research process on national problems such as energy and housing is a totally different one from that traditionally associated with basic scientific work. COPEP wants both social science and natural science disciplines to be involved in RANN projects; it wants many institutions to have a say about researching a problem; it urges the researchers to consider that the end product of their work is not a scholarly paper for an academic journal but a prospectus for societal change. The report spells out how RANN should do this in six areas.

► Energy. Perhaps the best passage justifying a philosophy of inclusiveness and diversity for RANN appears at the outset of the report of the panel on energy, which was headed by David Rose, chairman of the department of nuclear engineering at the Massachusetts Institute of Technology (M.I.T.).

> The major problem with energy is clear: as with most important policy questions, we don't know what we want as a nation. . . .
>
> The lack of consensus of objectives is the answer to the question, "If we can put a man on the moon why can't we . . .?" It also suggests the need for different research strategies than were used in the moon program.
>
> As the relative value of our resources changes, different technologies become more "efficient." Since we cannot predict how these values will be specified, we cannot be certain which technologies will be "economical."
>
> This calls for a research strategy which emphasizes diversity: the development of and assessment of social and technical options coupled with effective communication.

Whatever Are the Presidential Prizes?

Nine months ago, on 13 March, President Richard M. Nixon in his technology message to Congress announced that he would be awarding prizes for "outstanding achievements by individuals and institutions" for research and development, with the aim of encouraging "needed innovation in key areas of public concern."

According to staff sources, the work in culling names and choosing finalists has been completed, although to date no winners of the Presidential prizes for innovation have been announced.

Nor, for that matter, has the dollar amount of the prize money been disclosed, a fact which has been a source of some concern on Capitol Hill. During its 1973 budget hearings before Congress, the National Science Foundation did not mention that the Presidential prize money might come from its appropriation, but apparently serious thought has been given to taking the prize money from the budget of the NSF technology incentives program.

The long delay has whetted Washington appetites for finding out what, exactly, is in the works on this aspect of the President's technology incentives, and *Science* has obtained a list of the 15 finalists, by last name only and by field of contribution, from which the winners apparently have been selected. Many of these finalists—to the extent that their identities could be determined through checks with the scientific community—are well-established persons; six are members of the National Academy of Sciences (NAS) or the National Academy of Engineering (NAE). One institution is considered and only one finalist is actually labeled an "independent inventor."

Willem Kolff, head of the division of artificial organs, University of Utah was a principal developer of the artificial kidney machine.

George C. Cotzias, head of the physiology division of the medical research center, at Brookhaven National Laboratory, who was a principal developer of L-dopa, a drug used for Parkinson's disease.

Edward F. Knipling, of the Entomology Research Division, Department of Agriculture, and member of the NAS.

Edwin H. Land, president and director of the Polaroid Corporation, member of the NAS.

George E. Backus, of the Institute of Geophysics and Planetary Physics, La Jolla, California, a member of the NAS.

S. Donald Stookey, director of fundamental chemical research, Corning Glass Works, Rochester, N.Y., who invented the Pyroceram family of glass used in Corningware dishes.

Walter H. Zinn, vice president of Combustion Engineering, Inc., and member of the NAS, a pioneer of the nuclear reactor and former director of Argonne National Laboratory.

Electronic Systems Laboratory, Massachusetts Institute of Technology (M.I.T.), for developing automated machine tools now widely used in industry.

Samuel Ruben, director, Ruben Labs of New Rochelle, New York, is the only independent inventor. Ruben, 73, invented many devices critical to the development of radio and also to the electric heart-pacemaker.

Charles S. Draper, president of C. S. Draper Laboratory, which, when it was called the Instrumentation Laboratory, developed inertial guidance technology and the guidance systems used in the Apollo program.

Jerrold R. Zacharias, director of the Education Research Center of M.I.T., and NAS member. Zacharias is a physicist, but the prize would be given for his work in education.

Also on the list are four names that could not be identified with reasonable certainty; Rosen, who apparently contributed to communications, and Collipp and Davis, both of whom are listed as having achievements in the natural resource areas, and Frosch, whose work has aided productivity and international trade.—D.S.

So far in energy research, the panel says, the "crucial importance" of energy consumption and demand has been ignored and RANN ought to fill this gap. Faced with a host of federal agencies sponsoring research on fossil fuels and nuclear sources, RANN should concentrate on unconventional sources, such as solar energy.

► Natural hazards and disasters. "There is a basic lack of communication between those researchers who study these problem areas . . . and that segment of the population which must . . . actually minimize society's losses," says this panel. RANN now spends about $8.25 million on earthquake engineering and fire research; the panel recommended additional work on designing earthquake-resistant buildings, management of dangerous water areas (both of these emphasizing the information dissemination to the user), and setting up an experimental short-range weather warning service.

► Human resources. A theme of the COPEP study is finding ways RANN can get the most leverage for its relatively small research dollar. In social programs, RANN could economize by "piggy-backing" its own studies onto current social programs, the panel suggests. In general, RANN must broaden its social programs in many directions: the ongoing much-publicized study of the New York City sanitation work force should broaden to include hard technology aspects, while the rather straightforward applied social science work now done should be juggled to include institutional accountability, product safety, and the impact of broad-band communications.

► Community development. COPEP's Community Development panel gave RANN's hard-rock tunneling program relatively low marks, and urged that it be altered to include soft-rock tunneling, since soft-rock formations also occur beneath urban areas. In this report, as well as in the human resources panel report, were extensive outlines of how RANN could start studying "technological delivery systems" in municipal and local government, and other regionalized services.

► Growth and environment. RANN's present environmental programs consist, by and large, of straightforward analyses of trace contamination, modeling of river basin waters, pollution measurement, and weather modification. The COPEP panel, however, stressed that environmental questions were linked inexorably to questions of population growth and movement, the plight of areas in decay, and so forth. (Another panel recommended that some of RANN's environmental work could more profitably be done by other parts of NSF or by the Department of Agriculture. RANN's present work on environmental modeling was chastised somewhat; the panel said that more empirical information on interrelations was needed before the sort of computerized model that would be of any use to anybody could be built. Another interesting suggestion was that RANN set up a sort of environmental Gallup poll of American households to monitor changing patterns of product consumption.

► Wild cards. J. Herbert Holloman, director of the Center for Policy Alternatives at M.I.T., was chairman of a "wild card" panel (conventionally titled Targets of Opportunity), which was designed to toss up unorthodox suggestions and proposals. A main conclusion of the Holloman group, also mentioned elsewhere, was that RANN should set aside for other purposes a fixed percentage of its budget for high-risk projects that might be carried out by unconventional institutions in the general national interest of building up substantive and institutional alternatives to current conventional solutions. This panel, like the others, volunteered a lot of suggestions about RANN's administration, its relation to other government agencies, and its umbilical relation to NSF. The Holloman group, however, carried the most sting by suggesting that "the continuation of the present RANN-NSF relationship is likely to have adverse effects on both organizations."

Sociology and Criticism

COPEP had planned to delay consideraton of RANN's management problems until a later phase of the three-report series. Nonetheless, criticisms of RANN's management crop up throughout the panel reports. The gripes range all the way from complaints about the length of time of the review procedures to a more visionary suggestion that RANN would be better off in the Executive Office of the President! In this first report, the comments on maanagement are scattered and sometimes incoherent; COPEP still plans bravely to take up these questions, systematically, at a later stage.

Peer review was discussed by several panels, with the overriding message being that, for most RANN projects, the traditional system simply does not apply. Moreover, the system of majority voting followed by most scientific review committees, according to one panel, may ultimately hurt RANN's projects. Majority voting, argued the panel on human resources, will ultimately favor funding good but average proposals; other proposals, which involve more risk but might be highly innovative, will go by the boards with traditional voting. The group recommended a different system.

The end product of RANN research also will be different from conventional scientific publications, according to the engineers' group. Investigators must realize, says one report, that "the final outcome of applied research is social and economic change, not just an article for an academic journal."

Several panels stressed the need for RANN-sponsored researchers to produce reports which are not only intelligible to the layman but which "users" of the research can actually consult as a guide. One suggestion was for a mandatory follow-up period where RANN-sponsored researchers would have to seek to have their research results implemented.

This interim report was drawn up from interdisciplinary panels involving lawyers, businessmen, industry and university scientists, and many people associated with nonprofit research organizations. There were physical scientists on the panels who might have been expected to fight valiantly for the cause of further basic (rather than applied) research in NSF, but the COPEP report does not reflect this view. In fact, it does not take up the concerns, often voiced by physical scientists, that the RANN program will hurt NSF. (Upon hearing of the COPEP report and its urging RANN to do more software research, for example, one physics department chairman scoffed, "Of course the engineers said that. They want to rename it the National Engineering Foundation.")

However, Naftalin, who is COPEP executive secretary, regards these divisions of viewpoint among scientists and engineers about RANN as sociological. "The report really ducked these issues," he admits, but says that they will be faced in a later stage, when COPEP will have to spell out what sort of institutions—university or nonuniversity—and what sort of people—natural scientists or others—should make up "the best type of team to field" for

solving problems in this manner.

Naftalin adds that he thinks some of the rivalries between the basic science community, the engineers, and other groups will ultimately be broken down through exposure, as they were, he claims, in the summer panel workshops. "If you put a Berkeley political scientist in the same room with a retired G.E. vice president for 3 days, something's got to give," he says. Both Naftalin and Wenk point out that the individuals involved in the study, who might have been expected to take die-hard positions that RANN threatened the health of NSF and of basic university research, did not do so. And RANN chief Joel Snow points out that the National Science Board, which had expressed sharp concerns over RANN and a year ago was supervising every award of $5000 on up by RANN, has now relaxed, and reviews RANN only on a program-by-program basis. Evidently, then, the originators and authors of the study feel that the schisms which RANN has in the past revealed, can be mended. In the meantime, as far as COPEP's endorsement of the RANN program goes, the sky is the limit.

—DEBORAH SHAPLEY

RECENT DEATHS

Willy E. Baensch, 79; professor emeritus of radiology, Georgetown University Medical Center; 1 November.

Lewis N. Brown, 81; former professor of pharmacy, Columbia University; 20 October.

Lawrence N. Canjar, 49; dean, College of Engineering, University of Detroit; 6 November.

Hans T. Clarke, 84; former professor of biochemistry, Columbia University; 21 October.

Ross M. Coxe, 50; professor of education, University of South Carolina; 17 October.

W. Gayle Crutchfield, 72; professor emeritus of neurological surgery, University of Virginia; 31 October.

Con Fenning, 67; former professor of physiology, University of Utah; 14 October.

Joe M. Hopping, 41; dean, Graduate School, Central Missouri State University; 15 September.

Richard L. Huntington, 76; research professor emeritus of chemical engineering, University of Oklahoma; 9 October.

Walter R. Kirner, 77; former director of chemistry, National Science Foundation; 7 October.

G. David Koch, 69; former professor of geography, Indiana State University; 18 September.

Solomon Lefschetz, 88; professor emeritus of mathematics, Princeton University; 5 October.

Robert H. MacArthur, 42; professor of biology, Princeton University; 1 November.

Harlow Shapley, 86; professor emeritus of astronomy, Harvard University and former president, American Association for the Advancement of Science; 20 October.

John E. Walsh, 53; professor of statistics, Southern Methodist University; 24 August.

Robert C. Williamson, 84; professor emeritus of physics, University of Florida; 4 September.

Richard J. Winzler, 57; professor of chemistry, Florida State University; 28 September.

John D. Withers, 50; zoologist and assistant director, American Institute of Biological Sciences; 30 September.

RESEARCH NEWS

Fuel Cells: Dispersed Generation of Electricity

The fuel cell was discovered by Sir William Grove in 1839, but it remained little more than a scientific curiosity until the first practical fuel cell was demonstrated 120 years later by Francis T. Bacon and J. C. Frost of Cambridge University. Since that demonstration, fuel cells have been widely used in the space program, but their high cost has effectively precluded their use as earthbound power sources. Only recently has it begun to seem likely that the cost problems could be overcome and that fuel cells could be commercially viable within this decade.

The road to viability has been a strange one. The euphoria of the space program attracted a number of companies into fuel cell development, but disillusionment set in rapidly. It is comparatively easy to produce electricity efficiently and for long periods of time when money is no object; it is far harder, they found, to do it when that electricity must compete economically with the relatively cheap product of large commercial generators.

The federal government, furthermore, provided fuel cell research funds almost exclusively for space and military applications, and even those funds dropped from nearly $16 million in 1963 to about $3 million in 1970. Unwilling or unable to assume the substantial investment required for commercialization, companies that had so eagerly rushed into fuel cell development quietly abandoned their research programs or reduced them to token operations. At present, only one company is actively pursuing a full-scale commercial fuel cell program—the Pratt & Whitney Aircraft division of United Aircraft Corporation, East Hartford, Connecticut.

Pratt & Whitney did have some help though. The natural gas industry has supported its effort because fuel cells seem to present an attractive, environmentally sound way to obtain a premium rate of return on natural gas sales by upgrading the gas to electricity. The electrical industry has also provided support because fuel cells promise to be small, clean power sources that can be quickly installed throughout its distribution systems to supplement central power stations without objections from residents or ecologists.

To date, 43 U.S. and three foreign utilities and Pratt & Whitney have invested more than $50 million to prove the technical feasibility of commercial fuel cells. Roughly twice that amount is expected to be invested by the same groups during the next 3 years in an