Sahel Will Suffer Even if Rains Come

With potential population explosion, no Green Revolution, drought is only part of the problem confronting the region

The news from the Sahel region* of Africa is discouragingly familiar. As it did between 1968 and 1974, drought has caused the deaths of thousands of people, the decimation of livestock herds, and the loss of productive land to desert. This time the drought area is larger, extending through much of Africa south of the Sahara. And the emergency appears even more serious because it is occurring against the background of a crisis in development that afflicts most of Sub-Saharan Africa. Population growth is outstripping modest increases in food production. And a combination of high energy costs and a slump in world prices for exports from the region have devastated the vulnerable economies of those countries.

The last Sahel drought won world attention and caused a major mobilization of international relief, development assistance and research in behalf of the Sahel. But although assistance is now running at a level of nearly $1.7 billion a year, a decline in per capita food production has become an established trend. Concern about slow growth has prompted donor organizations to undertake intensive evaluations of development theory and practice in Africa.

In a speech in January, World Bank vice president for operations Ernest Stern struck a note of institutional self-criticism that is common today among development organizations. Assessing development efforts in Africa, Stern said, "We, I think it is fair to say, among all our achievements, have failed in Africa, along with everybody else. We have not fully understood the problems. We have not identified the priorities. We have not always designed our projects to fit the agroclimatic conditions of Africa and the social, cultural, and political frameworks of African countries. This is evidenced by the percentage of poorly performing projects in the agricultural portfolio and by the fact that we, and everybody else, are still unclear about what can be done in agriculture in Africa."

Stern went on to say that while he did not have the solutions, some of the elements were clear. Two main points were "we need to do very much more to support research," and "the designs of agricultural projects in Africa must be made more consistent with the implementation capacity of many of those nations."

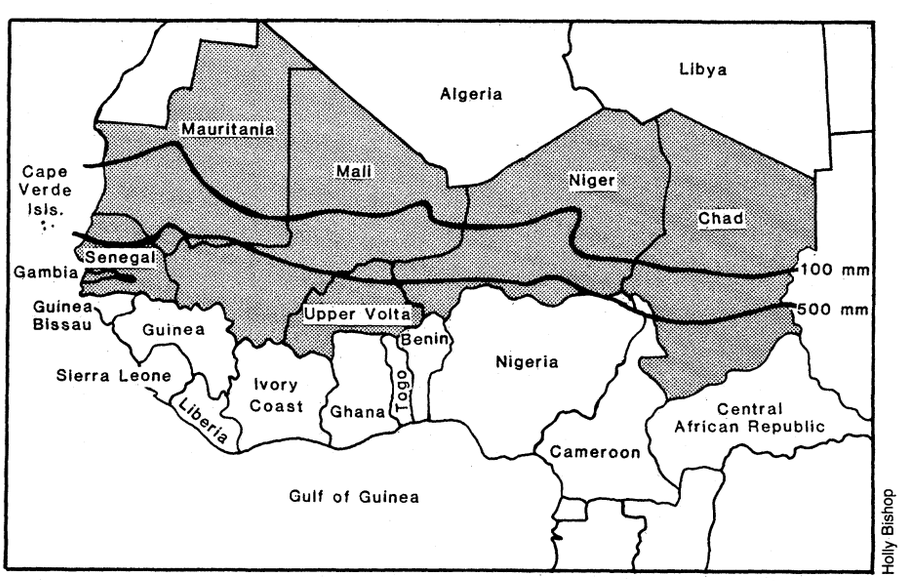
The immediate crisis, of course, is caused by 2 years of severe drought. Among the Sahelian countries, Mauritania appears to be most seriously affected. The drought is reportedly responsible for 100,000 deaths in Mozambique. Food relief is being provided for the hardest hit areas, but these efforts are impeded in a number of regions by inadequate transportation and distribution systems and, in several countries, by warfare and civil conflict.

Beyond the present emergency, however, loom formidable long-term problems of development. There is growing recognition that recurrent droughts impose an element of unpredictability in the Sahel that limits agricultural options available in other regions. Soil is fragile in the fashion of arid regions and population growth has resulted in overcultivation and overgrazing with destructive consequences.

The countries of the Sahel are among the poorest in the world. When they gained independence, they were woefully short of capital resources as well as of technically trained manpower and able managers. As new nations, they faced disputes with their neighbors and disunity among tribal and ethnic groups at home. Their governments generally reacted against the colonial past by following highly nationalistic, centralizing, socialist-oriented policies. These policies typically favored urban populations at the expense of rural people and agriculture. The result, in broad terms, was a decline in agriculture.

The experience of the 1970's convinced both donors and recipients that a long-term coordinated effort to increase food production was required and new strategies and organization needed to carry it out.

The eight Sahelian states in 1974 formed the Permanent Interstate Committee for Drought Control (CILSS) to provide a regional focus for action and make specific proposals for assistance. The principal donor countries followed in 1976 by forming the complementary Club du Sahel headquartered in the OECD (Organization for Economic Cooperation and Development) in Paris.



Sahel countries (shaded) straddle rainfall zone indicated by 100- and 500-mm isohyets.

*Sahel, an Arab word for coast or border, is normally used to denote six Sub-Saharan countries that won independence from France at the end of the 1950's—Mauritania, Mali, Niger, Senegal, Upper Volta, and Chad—plus the Cape Verde Islands and the Gambia. But similar conditions prevail in the countries that lie eastward along the tier such as the Sudan, Ethiopia, and Somalia. And drought conditions this year have seriously affected many countries in central and southern Africa, particularly Mozambique.

Desertification Defines Ordeal of the Sahel

The image of the sands of the Sahara advancing inexorably, engulfing everything in their path was a powerful symbol of the 1970's drought in the Sahel. Desertification, however, stands for a process of degradation of the environment that usually happens more slowly if no less surely than the dramatic stereotype. Desertification is a product of climate and human activity and in the Sahel it has been accelerated alarmingly by both.*

This interaction has been a main focus of research in the Sahel. In respect to climate, an earlier debate over whether the recent dry years were atypical seems to have given way to agreement among climate researchers that the dry period that began in 1967 in the Sahel falls into a pattern of sparse, highly variable, and unevenly distributed rainfall that has prevailed in the region for the last 2500 years.

What certainly differs is the pressures exerted on the ecosystem in the last 50 years by population growth and changing patterns of land use. Human activity, of course, has been significant for much longer than that. A millennium ago, the inhabitants of the Sahel were mainly nomads, living by herding and hunting. Major impacts on the ecosystem were made by bush fires set to improve grazing or aid hunting and by the caravans engaged in the trans-Sahara trade. A single caravan could include several thousand animals; the practice was to send out hundreds of people to cut trees for charcoal to be used as fuel on the desert-crossing and for emergency rations for the animals. The fires and the tree-cutting began the trends toward simplification of vegetation and degradation of the soil that plague the Sahel.

Arab chronicles testify that in the centuries before European nations began to vie for trading advantage a complex economy was maintained despite turmoil in the region. One feature was the warehouses in which supplies of food for several years were stored against crop failures. Famines seem to have occurred when drought coincided with local wars.

European colonization brought pacification resulting in the extension of settled agriculture northward into the Sahel and new stresses on the fragile soil. The colonial era also saw the enlargement of cattle herds and the displacement of camels by cattle as the basis of the economy and culture. Cattle, however, are poorly suited to the Sahel. They require large quantities of water, have a low conversion efficiency as feeders, and are vulnerable to stress. Many deep tube wells have been sunk in the region to water livestock. Especially in dry weather, the congregation of cattle around water sources causes wide areas to be denuded of vegetation and desertification accelerated.

Traditional agriculture in the Sahel represented a sophisticated adaptation to the conditions in the region. Land was relatively plentiful and farmers would cultivate a plot for 2 or 3 years then allow it to remain fallow for 10 years or more. Trees were left on cultivated land, contributing to soil stability and fertility, and providing browse for animals. Land tenure systems varied widely, but in general allowed multiple use and multiple users. Herdsmen and farmers cooperated, for example, with livestock often allowed to forage on harvested fields, their droppings, in turn, fertilizing the land.

Under the old system, the movement of people was relatively unrestricted and, in bad times, they were adept at finding water and filling out their diet by hunting and gathering. Limits on migration imposed by national boundaries, land use rules imposed by the new governments, and urbanization have nullified these survival skills.

Recognition that desertification vitiates action to increase food production has encouraged antidesertification efforts in the past decade. An evaluation of those efforts is contained in a report prepared as a follow-up to a 1977 U.N. conference on desertification. The report, "Assessment of Desertification in the Sudano-Sahel," is the product of a study sponsored by the Sudano-Sahelian office of the U.N. and headed by Leonard Berry of Clark University.

The report finds some causes for encouragement, particularly in a spreading awareness of the problem of desertification and the creation of new institutions and the strengthening of existing ones to combat it. Among antidesertification projects such as those aimed at sand dune fixation, reforestation, creation of woodlots, and provision of substitutes for fuelwood, some successes are described. The verdict, however, is that "Despite the efforts of all concerned the record of success in the battle against desertification is at best mixed." A majority of indicators developed to assess environmental change show moderate or severe deterioration in the region. "The reasons for this are numerous but high among them are still the lack of defined practical policies of resource management by the governments, inherent problems of marginal land development and the need for innovative approaches, the dearth of trained national personnel and the serious shortage of funds put to this end." Asked to sum up the difficulties, Berry said, "A shortage of money. A shortage of good concepts of what to do. And an inability to implement good concepts."

The report makes the point that evaluations of progress or lack of it on desertification are limited by still inadequate data and it urges vastly improved monitoring of land and resource conditions and climate. Although the debate on whether the current dry years were an anomaly seems to have quieted, not all the questions have been answered. A new discussion has been simmering since the mid-1970's over the possibility of what is termed biogeophysical feedback. In a 1982 paper, "Sahel: A Climatic Perspective," prepared for the Club du Sahel, Sharon E. Nicholson of Clark University wrote that, "Several researchers have proposed various mechanisms by which droughts can 'self-accelerate.' The changes of the land surface induced by a drought (removal of vegetation, increased reflectivity, reduced soil moisture) in turn influence the atmosphere in such a way as to strenghten conditions that first produced the drought. . . . The persistence of conditions of abnormal rainfall over one or two decades may be manifestations of such 'feedback' between the atmosphere and surface." The issue remains unsettled, but it would seem grimly consistent with the recent fortunes of the Sahel if drought proved to be self-perpetuating.—**J.W.**

*Environmental history and baseline information on the Sahel are discussed in a report, *Environmental Change in the West African Sahel* (National Research Council, Washington, D.C., 1983).

The World Bank and its associated lending agencies sharply increased their programs for the Sahel and other regions of Africa. And the U.S. Agency for International Development (AID) in 1977 established a separate Sahel Development Program and upped the level of assistance.

The $1.7-billion funding level for 1983 represents a resumption of a general upward trend after a falling off in 1982. In the period 1975 to 1982 nearly $11 billion in assistance was provided with France, the largest donor, accounting for nearly 20 percent of the total. About 35 percent of the total during the period was not spent on development projects but on such things as food imports and debt service that did not contribute directly to solving the region's long-term problems. The U.S. contribution was about $135 million last year, some $85 million in development assistance and $37 million in food aid.

It is difficult to trace trends in research funding because research support is often included in development project grants and contracts. Funding is said to be increasing substantially for applied research on agricultural and environmental problems, however. Lack of such research is viewed as a partial answer to the obvious question of why the Green Revolution has largely missed Africa.

A wide-ranging 1981 report, *Food Problems and Prospects in Sub-Saharan Africa: The Decade of the 1980's*, done by the U.S. Department of Agriculture Economic Research Service for AID suggests several reasons why agriculture in the region has fared relatively poorly. In technology terms, Africa has lacked the packages of inputs that made for success elsewhere. Rice varieties raised so successfully in Asia proved highly vulnerable to disease in Africa. And plant breeders have so far not developed high-yielding crop varieties adapted to African conditions. In Asia, the Green Revolution flourished in irrigated conditions. Irrigated farming in Africa has not had the advantages of farmer experience and commercial marketing and transportation systems that existed in Asia. And both funds for fertilizer and other inputs and agricultural labor have been in short supply.

Similarly, limited research has been done on improving rainfed agriculture in African conditions. Only now is work beginning on the formidable task of producing plant varieties more resistant to drought, disease, and insects there.

Other items on the research agenda include studies in support of agroforestry to find ways to improve on the old practice of growing woody plants, food crops and livestock on the same land (see box). Research on the hydrography of the region is needed to make better use of limited water resources. And livestock research, pioneered by the French, is viewed as needing to be greatly expanded. But development experts agree that better understanding of underlying environmental and resource problems must be backed by new economic, political, and social policies.

Earthscan

Herds on the move in Niger.

Development strategy has evolved rapidly during the past decade. During the 1950's, Africa received little attention from the international development community. In the Sahel, rainfall had been greater than usual through the decade. Many African countries were emerging from colonial rule and the U.S. view at the time was that development aid in the area was the responsibility of the former colonial powers. The outlook changed in the 1960's both because the drought elicited a humanitarian response and because the countries of Sub-Saharan Africa registered a strong claim for development assistance.

Conditions in the Sahel contributed to a major shift in the focus of development programs in the early 1970's. This was signaled in a speech in Nairobi in 1973 by Robert S. McNamara, then president of the World Bank. McNamara indicated that the bank would reduce emphasis on support of major capital projects such as highways, railroads, dams, power plants, and port facilities designed to give a developing country an infrastructure required for a modern economy. A main objection to such projects was that development depended on a trickle-down effect. More bank resources were to go into projects to aid directly the poorest people, especially smallholders and the landless, in the poorest countries. The main vehicle for such assistance was to be integrated rural development projects designed to introduce and support new technologies that promised to increase agricultural productivity.

The McNamara model won wide acceptance among development planners, but encountered some difficulties in implementation. What is involved is a technology transfer process that requires project designers to work with local people to be sure that proposed technology is appropriate and can be absorbed. Despite mounting research activity, gaps in knowledge continued to hinder effective design efforts. In addition, cooperation of government officials in the recipient country at the national, regional, and local levels is necessary if a program is not to be an isolated pilot project with no real prospect of being adopted more widely. Such cooperation was frequently lacking.

Furthermore, in some ways, grand-scale infrastructure projects are easier for both donors and recipients to carry out. Building a highway or an airport requires the sort of concentration and deployment of resources and manpower that Western contractors excel at. In a developing country it may be more difficult to establish and operate a successful system of rural clinics than a central hospital or to make an irrigation project work than to construct a major dam. At the secondary level there is often a continuing need for the trained manpower and managerial expertise that is in short supply in many developing countries. Also a factor is the problem of recurrent costs. Unlike the one-shot capital investment that often suffices for big infrastructure projects, many agriculture, health, education, and transportation projects of direct benefit to rural people require continuing support which developing countries find difficult to finance.

Donor nations have increasingly blamed the difficulties of development on the domestic policies of the recipient nations. The practice of setting investment, trade, and exchange policies to

NAE Elects New Members

The National Academy of Engineering has elected 58 new members and five new foreign associates. This brings the total U.S. membership to 1187 with 105 foreign associates. The new members are:

Harl P. Aldrich, Jr., Haley & Aldrich, Inc., Cambridge, Mass.; **Dell K. Allen**, manufacturing engineering, Brigham Young University; **William A. Anders**, Textron, Inc., Providence, R.I.; **Arthur Ashkin**, laser science research, AT&T Bell Laboratories, Holmdel, N.J.; **Nicolaas Bloembergen**, applied sciences, Harvard University; **Theodore A. Burtis**, Sun Company, Inc., Radnor, Pa.; **Anil K. Chopra**, civil engineering, University of California, Berkeley; **Richard J. Coar**, United Technologies Corp., East Hartford, Conn.; **Donald E. Coles**, aeronautics, California Institute of Technology; **James W. Dally**, IBM Corp., Manassas, Va.; **F. Paul de Mello**, Power Technologies, Inc., Schenectady, N.Y.; **Robert H. Dennard**, IBM Corp., Yorktown Heights, N.Y.; **Joseph F. Engelberger**, Unimation, Inc., Danbury, Conn.

John V. Evans, COMSAT Laboratories, Inc., Clarksburg, Md.; **Alexander Feiner**, integrated systems, AT&T Information System, Holmdel, N.J.; **Daniel W. Fox**, plastics technology, General Electric Co., Pittsfield, Mass.; **Robert S. Hahn**, Hahn Associates, Northboro, Mass.; **Robert D. Hanson**, civil engineering, University of Michigan, Ann Arbor; **Albert G. Holzman**, industrial engineering, engineering management and operations research, University of Pittsburgh; **Lawrence E. Jenkins**, Lockheed Missiles & Space Co., Austin, Tex.; **John F. Kahles**, Metcut Research Associates, Inc., Cincinnati, Ohio; **Thomas Kailath**, electrical engineering, Stanford University; **Ivan P. Kaminow**, photonics circuits research, AT&T Bell Laboratories, Holmdel, N.J.; **Jack D. Kuehler**, information systems and technology group, IBM Corp., White Plains, N.Y.; **Butler W. Lampson**, research systems center, Digital Equipment Corp., Palo Alto, Calif.; **John W. Leonard**, engineering, Morrison-Knudsen Co., Inc., Boise, Idaho; **Philip W. Lett, Jr.**, land systems division, General Dynamics, Warren, Mich.

Miles C. Leverett, private consultant (nuclear power), Monte Sereno, Calif.; **Peter W. Likins**, Lehigh University; **Dan Luss**, chemical engineering, University of Houston; **James W. Mayer**, materials science and engineering, Cornell University; **David W. McCall**, chemical research laboratory, AT&T Bell Laboratories, Murray Hill, N.J.; **Walter J. McCarthy, Jr.**, Detroit Edison, Mich.; **Carver A. Mead**, computer science, California Institute of Technology; **Robert Mehrabian**, School of Engineering, University of California, Santa Barbara; **Franklin K. Moore**, mechanical engineering, Cornell University; **Thomas J. Murrin**, energy and advanced technology, Westinghouse Electric Corp., Pittsburgh, Pa.; **Paul M. Naghdi**, mechanical engineering, University of California, Berkeley; **Hyla S. Napadensky**, fire and explosion research, IIT Research Institute, Chicago; **Thomas K. Perkins**, production research, ARCO Oil and Gas Company, Dallas, Tex.; **Dabbala R. Reddy**, computer science, Carnegie-Mellon University.

Eli Reshotko, engineering, Case Western Reserve University; **Dominick J. Sanchini**, Rocketdyne Division, Rockwell International Corp., Canoga Park, Calif.; **John H. Schmertmann**, Schmertmann & Crapps, Inc., Gainesville, Fla.; **Roger A. Schmitz**, engineering, University of Notre Dame; **Joseph L. Smith, Jr.**, mechanical engineering, Massachusetts Institute of Technology; **Harold G. Sowman**, 3M Company, St. Paul, Minn.; **William E. Splinter**, agricultural engineering, University of Nebraska, Lincoln; **Marshall B. Standing**, retired senior engineering consultant, Standard Oil Company; **G. Russell Sutherland**, product engineering, Deere & Company, Moline, Ill.; **Joseph F. Sutter**, Boeing Commercial Airplane Company, Seattle, Wash.; **Leo J. Thomas**, Kodak Research Laboratories, Rochester, N.Y.; **Jerome J. Tiemann**, physicist, General Electric Research and Development Center, Schenectady, N.Y.; **Charles F. Tiffany**, research and engineering, Boeing Military Airplane Company, Wichita, Kans.; **Leland J. Walker**, Northern Engineering and Testing, Inc., Great Falls, Mont.

Sheldon Weinig, Materials Research Corp., Orangeburg, N.Y.; **Basil W. Wilson**, consulting oceanographic engineer, Pasadena, Calif.; **John Zaborsky**, systems science and mathematics, Washington University, St. Louis, Mo.

The new foreign associates are:

Marcel L. J. Barrere, directeur des recherches, Office National d'Etudes et Recherches Aerospatiales, Châtillon, France; **Donald F. Galloway**, consulting engineer, Leics, England; **Claude P. Seippel**, consultant, Brown Boveri Company, Zurich, Switzerland; **Eugene D. Shchukin**, director, laboratory for physico-chemico mechanical phenomena, Institute of Physical Chemistry, Academy of Sciences of the U.S.S.R.; **Haldor F. A. Topsoe**, president, Haldor Topsoe A/S, Copenhagen, Denmark.

protect nascent industries was seen as damaging to agriculture. A particular target of the critics was the so-called parastatal agencies which in many Sahelian countries were given control over consumer and producer prices and granted authority to market food and conduct trade relations. These agencies, typically, have kept farm gate prices low, subsidizing food for city dwellers, but depriving farmers of incentives to venture beyond subsistence agriculture.

An influential document in this discussion is a World Bank report, *Accelerated Development in Sub-Saharan Africa: An Agenda for Action*, known as the Berg Report for Elliot Berg who headed the staff group that wrote it. Published in 1981 with an update in 1983, the report is regarded as a major expression of the case for "conditionality," that is of international agencies making approval of projects conditional on agreement by recipients to make specific policy and institutional changes.

The report certainly does not advocate that the bank simply issue take-it-or-leave-it ultimatums to would-be clients. Rather it argues that conditions in Africa require that the bank make more money available and change its own policies, for example, to finance recurrent costs in projects that require it and to provide funds to support policy reforms.

From the viewpoint of the recipient governments, making policy changes involves decided difficulties and risks. After independence, authorities had little choice but to rely on a small educated elite and expatriate specialists. Advice to shift economic power to the private sector may be logical, but in many countries the private sector is feeble. And policies rigged to subsidize food and imported goods for urban populations may be economically unsound but politically prudent. Devaluation of the currency can be a rational step fiscally, but it may also be a recipe for a coup. Nevertheless, the Sahelian countries to varying degrees have adopted policies designed to bolster production of food for domestic use and revised pricing, marketing and tax policies to support the new priorities.

Many observers see external constraints—drought, low world commodity prices, energy costs—as the major current obstacle to development. Others see the reliance of Sahelian countries on food aid and financial support as creating a long-term dependence on such assistance. Probably most threatening to the Sahelian future, however, is population growth. Common estimates have population in the region growing at an annual 2.7 percent and food production at 1.5

percent. Continuation of the trend would negate even dim hopes for food sufficiency for the region. A 1983 report on development looking to the year 2008 by the U.N.'s Economic Commission for Africa says that the picture that emerges "under the historical trend scenario is almost a nightmare." Effects on physical resources and social services would be disastrous and "socioeconomic conditions would be characterized by a degradation of the very essence of human dignity."

Population control plays little part in current development programs or government policies in the region. African attitudes toward family planning have traditionally been conditioned by suspicion of donor country motives. French aid policy has not given family planning much place and current U.S. policy has prescribed provision of assistance for voluntary programs only when such aid is specifically requested. The issue has been recognized as a sensitive one politically for Sahelian governments, which do not lack for threats to stability. U.S. population experts, however, detect a willingness among Sahelian officials to discuss the population problem, which is seen as a hopeful development.

In a matter of weeks, the Sahel will begin to see whether the seasonal rains that make it possible to plant and grow the crops of the region will return or whether the drought will continue. But among the stern constraints that retard development in the Sahel, population growth is seen by many as the factor that will determine whether the region in the future will go from crisis to catastrophe.—**JOHN WALSH**

DeLauer Questions DOD Censorship

Richard DeLauer, the Pentagon's top scientist, last week distanced himself from recent proposals to control the publication of unclassified but potentially sensitive papers arising from university research. Speaking at a meeting of the DOD–University Forum, a twice-yearly session involving several university presidents and Defense Department officials, DeLauer took issue with the very notion that there should be a special category of unclassified research requiring restrictions. Defense contracts with universities should be either classified or unclassified, with no publication controls, he said.

The Department of Defense recently proposed that university scientists working on defense contracts in sensitive areas of applied research and exploratory development should submit their papers to the Pentagon for clearance 90 days before sending them to a journal for publication. The department would have the right to insist on changes or withhold approval for publication (*Science*, 13 April, p. 134). Leo Young, director of the office of research and laboratory management in the Pentagon, estimates that these restrictions would apply to perhaps 1 percent of contracts between the department and the universities.

These proposals have sparked protests from the universities and prompted the presidents of Stanford, MIT, and California Institute of Technology to send a letter jointly to DeLauer and George Keyworth, President Reagan's science adviser, stating that "absent any change in research policy—which we regard as very unlikely—our institutions would be unable to accept any research contracts subject to such a restriction."

When the matter was brought up at the forum meeting, DeLauer initially said he did not understand the problem. If publication restrictions were written into contracts, universities could decide whether to accept them on those terms, he said.

Several university presidents pointed out that many major research universities would not cede authority over publication to any sponsor, and would thus stay away from these sensitive research areas. DeLauer then said he saw no reason to make a distinction between sensitive and classified research. If information should be kept secret, then classify it; if not, then it should be unclassified. "I don't think we ought to add the burden of another category," he said.

DeLauer found some support from Robert Cooper, director of the Defense Advanced Research Projects Agency, who called the idea of sending even 1 percent of university research papers to the Pentagon for prepublication clearance "a prescription for constipation."

This put both men in opposition to Edith Martin, deputy under secretary of defense for research and advanced technology, who chaired a committee that came up with the proposal for prepublication approval and had just defended it to the forum. Martin, who is DeLauer's deputy, chairs a panel within the department that will implement whatever policy is finally adopted.

Richard DeLauer

Challenged the notion that DOD should approve the publication of unclassified research papers.

Aside from the fact that publication controls are anathema in themselves, there is concern among some university officials that if the department's proposal is adopted, the area of research subject to prepublication approval may expand in the future. On the other hand, if there is nothing between classified and unclassified, more research may end up being classified; few major research universities will accept classified contracts.

A working group of the DOD–University Forum has been given the task of trying to find a way out of the current impasse. It will also tackle what could turn out to be an even more contentious issue: the possibility that defense contracts may require foreign nationals to be excluded from participating in some sensitive research projects. Discussion of that possibility is on the agenda of the panel chaired by Martin.—**COLIN NORMAN**