tually, but he is not "pushing" for the present. "I really don't know how Delaney should be changed," he says.

The question of "how" seems to be the crux of the matter. A significant number of scientists believe that the Delaney clause is too rigid, that it is not really scientifically defensible. But when it comes to proposing an acceptable alternative, they are stuck with the fact that that means establishing some kind of threshold. There is general consensus that the state of the art is not up to that at the moment. Establishing a threshold is a no-win issue. As one investigator put it, "I feel, in a biological sense, that there must be a threshold." But it is hard to translate that into specific experimental procedures and limits for analysis. He astutely calls the Delaney clause "scientifically hard to live with but morally hard to argue with."

—BARBARA J. CULLITON

Arms Control: White House Whittles Down Peace Agency

The White House apparatus for enlisting outside advice on arms control and defense matters has been thrown into a state of flux and the shape of the rescue effort, if there is to be one at all, is far from clear. The Arms Control and Disarmament Agency (ACDA) has recently been dealt two body blows, which, although less than fatal, suggest a sudden coolness in the White House's affection for the agency. The President's Science Advisory Council (PSAC), formerly a source of arms control advice, has long been moribund and awaits only a decent burial. Apart from the considerable expertise available to the intelligence agencies, it may be that the main channel for independent scientific advice to reach the White House will be via Henry Kissinger's private brain trust.

ACDA's two misfortunes are a 33 percent cut in its new budget and loss of the chairmanship of the U.S. delegation to the strategic arms limitation talks (SALT). White House spokesmen deny that the agency is being downgraded.

The savings made in ACDA's budget, which Senator William Proxmire (D–Wis.) points out will amount to about a third of the price of a single F-14 airplane, will fall chiefly on the agency's external research program, and there will also be a small loss of staff.

More serious in terms of influence is ACDA's apparently reduced role in the SALT talks. Until his resignation last month, Gerard C. Smith was both head of ACDA and chairman of the American delegation to the SALT talks. The White House has now decided to separate the two jobs, on the grounds that the SALT negotiator is too often abroad to be able to run ACDA as well. The new negotiator, Under Secretary of State U. Alexis Johnson, is considered likely to be a temporary appointment because of his age (64) and relative inexperience in dealing with arms control issues. It is not yet known who will be head of ACDA or whether the top staff, who have turned in their resignations, will be replaced. A report current in Washington is that the agency was offered to Harold Agnew, director of the Los Alamos Scientific Laboratory where nuclear warheads are designed. Agnew, who is said to have refused the offer, declined to comment.

While it is too early to tell the White House's intentions for ACDA—much will depend on who the new director is—the present prognosis is gloomy. The possibility of further moves against the agency seems to have at least been discussed within the White House. One hypothesis is that Nixon is downgrading ACDA as a sop to the conservatives. Another conjecture is that he wishes to have all advice on arms control matters concentrated within the White House.

If ACDA is to be dissolved, whether outright or in practice, relatively more importance may be attached to certain informal channels of advice. Although PSAC is just about over with, the National Security Council has received advice on arms control matters from various PSAC panels, although not on an institutionalized basis, and from selected individuals. A group of Cambridge scientists and others, which serves as a kind of private brain trust to presidential adviser Henry Kissinger, has been active in the past and may be so again.

The brain trust is chaired by Paul M. Doty, professor of chemistry at Harvard, and apparently evolved out of another Cambridge-based organization, the Soviet-American Study Group. The study group, which is affiliated with the American Academy of Arts and Sciences, meets once every 6 weeks and, about once a year, meets with a counterpart group in the Soviet Union. Its purpose is to discuss long-range problems of arms control, rather than day-to-day negotiating positions.*

Kissinger is a former member of the study group but resigned on joining the Administration. There is no formal relationship between the study group and the Kissinger brain trust other than an overlap of membership. The brain trust is said to have been concerned almost exclusively with matters arising out of the SALT negotiations.

In recent weeks, Kissinger has been preoccupied with Vietnam, and arms control matters have hung fire. Whatever machinery emerges for handling the second round of SALT talks, proponents of arms control are anxious for ACDA to continue to play a front-line role. The agency played a crucial part, as they see it, in helping the first round of SALT talks to fruition. Many of the significant papers in the first round were drafted jointly by ACDA and the Office of the Secretary of Defense. The agency formed a necessary counterbalance to the military, both in providing analysis and in the interagency discussions—part of the Kissinger system for educating the bureaucracy in arms control positions (such as the SALT concession allowing the Soviets 62 missile submarines to the United States' 44).

Most of the relevant material is classified, hence without a group such

* Present members of the Soviet-American Study Group include Paul Doty, chairman, Benjamin Brown (Harvard), executive secretary, Richard Garwin (IBM), Carl Kaysen (Princeton), Franklin A. Long (Cornell), Wolfgang Panofsky (Stanford), George Rathjens (M.I.T.), Jack Ruina (M.I.T.), Marshal Shulman (Columbia), Louis Sohn (Harvard), Jerome Wiesner (M.I.T.), and Cyrus Vance, former U.S. negotiator at the Paris peace talks.

as ACDA inside the government, there would be no one to speak for arms control. Arms control lobbyists fear that the effective demise of ACDA, if this is what the White House plans, could fatally weaken the impetus for further arms control agreements.

It is of course possible that the White House does not wish to progress too hastily with SALT. The agreement negotiated last May runs for 5 years. And striking bargains with the Soviets, a former Kissinger aide observed recently, is only 60 percent of the problem; the rest is domestic politics. The so-called missile gap assisted Nixon's defeat in 1960. An instance that occurred early in the SALT talks was when, through fear of stirring up the hardliners, the White House reneged on an offer, already accepted by the Russians, to limit ABM systems to the sites of the national capitals. The White House, it may be surmized, does not consider ACDA the best place for keeping control over the domestic implications of such issues.—NICHOLAS WADE

Erratum: In "Metabolite distribution in cells," by R. H. Davis (24 November 1972), two errors occurred. On page 839, column 3, line 20, "CPS-A" should read "CPS-P". In Fig. 2, on page 837, parentheses enclosing "ureidosuccinate" and "uridylic acid" in the lower part of the figure should instead have enclosed the same words in the upper part of the figure.

RESEARCH NEWS

Perfluorochemical Emulsions: Promising Blood Substitutes

Blood is a highly complex liquid with many components and a variety of functions, the most important of which include transport of oxygen and metabolic substrates to tissues, removal of carbon dioxide and metabolic products, and maintenance of the concentration of ions and other solutes in extracellular fluids. Many widely used substitutes for blood serum perform some of these functions, but none provides adequate oxygen transport, which may be the most critical function since oxygen deprivation leads to rapid death.

Recently, however, a small number of investigators have begun to demonstrate that certain perfluorochemicals—organic compounds in which all hydrogen atoms have been replaced by fluorine—can supply oxygen transport and, in conjunction with a simulated blood serum, perform many functions of whole blood. These combinations have been used in several laboratories to maintain physiological function in isolated organs and to replace a substantial part of the blood of laboratory animals. One group has also used them for complete replacement of the blood of mice. Clinical trials have not yet been performed in humans, but a major barrier to such research, the propensity of perfluorochemicals to accumulate in body tissues with unpredictable effects, may have been overcome with the discovery of two perfluorochemicals that are rapidly eliminated from animals.

The need for a blood substitute was again made clear during the recent New Year's holidays when the reserves of blood banks in major areas of the country were nearly depleted. The annual seasonal decline in donations and increase in accidents forced hospitals in many cities to restrict or postpone elective surgery and to rely more heavily on commercial sources of blood, with a concomitant increase in the risk of hepatitis and other infections.

Even when adequate blood supplies are available, major problems abound. Blood is very expensive to collect, store, and administer. It is highly perishable, and thus cannot be used for routine treatment of accident victims at the site or stored for more than a short time. Incompatibility is a major problem: administration of blood of the wrong type can lead to an immune response far more serious than the condition being treated, and lifesaving transfusions may be perilously delayed during typing of the recipient's blood or during a search for a rare blood type. Blood supplies for animals are virtually nonexistent. Development of a universal blood substitute would ease or solve all of these problems and, in addition, provide a valuable tool for physiological research.

But obtaining a suitable oxygen carrier is difficult, both because of the scarcity of materials that can bind oxygen reversibly and because of the body's strong propensity for clearing foreign substances from the bloodstream. Even hemoglobin, when not incorporated in an erythrocyte, does not carry oxygen, and some scientists suggest that it is rapidly removed from circulation.

Oxygen is highly soluble in liquid perfluorochemicals, however. Whereas salt water or blood plasma dissolve about 3 percent oxygen (by volume) and whole blood about 20 percent, perfluorochemicals dissolve 40 percent or more; carbon dioxide is at least twice as soluble. In 1966, Leland C. Clark, Jr., of the University of Cincinnati College of Medicine demonstrated this high oxygen solubility by submerging mice in inert liquid perfluorochemicals for extended periods (Fig. 1). The animals were able to obtain sufficient oxygen by breathing the liquid and, upon removal, showed no apparent ill effects from the experience. Clark has also shown that breathing such liquids can

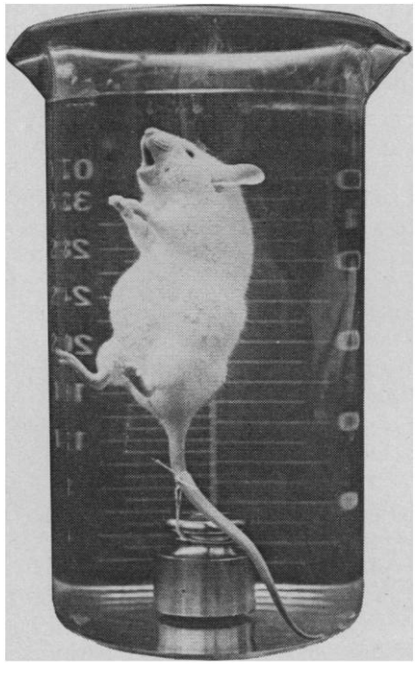

Fig. 1. A mouse breathing perfluorobutyltetrahydrofuran. After an hour's immersion, the mouse was inverted to drain the liquid from its lungs, and is now alive and well. [Source: Leland C. Clark, Jr., University of Cincinnati College of Medicine]