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have begun to demonstrate that certain perfluorochemicals—organic compounds in which all hydrogen atoms have been replaced by fluorine—can supply oxygen transport and, in conjunction with a simulated blood serum, perform many functions of whole blood.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

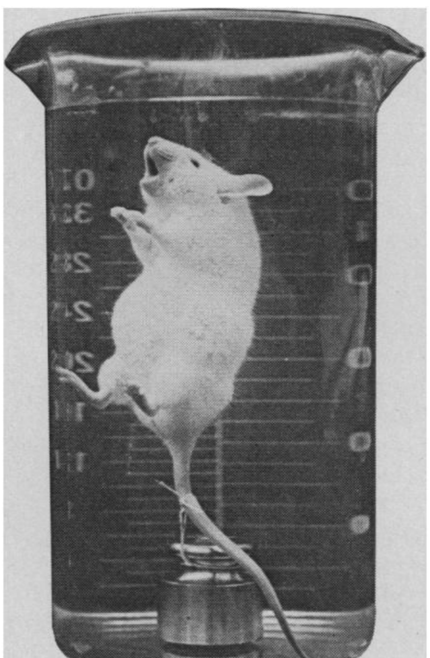

Fig. 1. A mouse breathing perfluorobutyltetrahydrofuran. After an hour's immersion, the mouse was inverted to drain the liquid from its lungs, and is now alive and well. [Source: Leland C. Clark, Jr., University of Cincinnati College of Medicine]