spending of the Atomic Energy Commission—had increased by $31 billion to approximately its present size. Operational and force levels were of course much higher in fiscal 1969 than they are today. There were then 3.4 million uniformed personnel, some 1.2 million more than at present. Strategic forces then were at about the same strength as now except that today there are fewer B-52 bomber squadrons, but more missiles with multiple warheads. But conventional or "general purpose" forces—tactical air wings, attack and antisubmarine carriers, airlift and sealift forces, and so on—were all at higher levels 5 years ago.

Where, then, did the peace dividend go? There has been no decline in the military budget primarily because of two legacies of the Vietnam war—inflation and the "all-volunteer force," with its extraordinary high payroll costs. Economists seem to agree that the wartime inflation, which zoomed upward to an annual rate of more than 6 percent in 1970 before it was finally checked, resulted from the government's failure to raise taxes promptly and avoid a deficit when military costs began escalating in 1965 and 1966. The price index for defense as well as other federal purchases is now up by more than a third of what it was in fiscal 1964. The idea of an all-volunteer army gained political currency as the military draft became one of the detested symbols of an unpopular war. Accordingly, the goal of phasing out the draft—this has just now been completed—and creating an all-volunteer force was adopted by Richard M. Nixon in his 1968 campaign platform as a way to defuse the war at home.

To attract the volunteers, the Administration and Congress set about to increase military pay and did so with a vengeance. In 1964 the basic pay of an Army recruit was $78 a month; by 1972 it had risen to $332 a month. A sergeant's basic pay during this period went from $205 per month to $467, a colonel's from $985 to $2057. The budgetary impact of the higher pay scales and allowances for active duty personnel, plus increasing benefits for retired personnel, was to be enormous. In fiscal 1968 the budget (actual outlays) for the Department of Defense was $78 billion, and, of that total, 42 percent was allocated to manpower costs, 42 percent to "investment" (weapons procurement, research and development, and construction of facilities), and the remainder to costs of operations. Under the fiscal 1974 budget, however, the share for manpower has risen to 56 percent and the share for investment has declined to 29 percent. The one encouraging sign Pentagon officials have noted is that over the past year these percentages have held steady, with no further erosion in the investment category.

There is expected to be one modest peace dividend, part of which can be applied to modernization of forces. Preparation of the new budget was completed prior to the announcement of the peace agreement, but, by taking into account the continuing "Vietnamization" of the conflict, the budget does show a decline of $3.3 billion from the $6.2 billion to be spent during the current fiscal year in Southeast Asia. Whether there will be any additional "dividend" from the Vietnam peace is not yet known. Investment in weapons procurement, R & D, and construction of facilities will rise by about $1.3 billion. Allocations for basic research will go up by about $29.6 million, remaining at about $0.5 billion overall, and the total for all R & D increases from $6.5 billion to $7.4 billion (this stated in terms of "obligational" authority rather than of outlays).

Development of three new strategic weapons would be continued under the new budget—the so-called antiballistic missile "Site Defense," the B-1 bomber, and the Trident ballistic missile submarine. The Site Defense is designed to defend U.S. Minuteman missile sites. The Strategic Arms Limitation Talks (SALT) agreement bans any deployment of such a system beyond the existing installation at Grand Forks, North Dakota, and one for the protection of Washington, D.C. (which the Administration apparently now has no intention of building). Further development of the system is referred to in the budget document as a "hedge" against possible abrogation by the Soviets of the SALT agreement.

The Air Force hopes to buy 244 B-1 bombers over the next 10 years, at a cost of about $11 billion. The Navy intends to build 10 Trident submarines, at a cost of $13.5 billion (unofficially, there have been reports that the Navy hopes to build perhaps as many as 15 or more of these submarines). The need for Trident and the B-1 has been disputed by the Federation of American Scientists, which includes among its leaders such strategic arms experts as Herbert F. York (former director of Defense Research and Engineering), and by the Center for Defense Information, a new group headed by a recently retired rear admiral who has held important sea commands. The 1974 budget document indicates that the real purpose of moves to deploy new systems such as Trident and the B-1 is to "provide the Soviet Union an incentive for meaningful negotiations" in the new round of SALT talks. This, in a word, is the "bargaining chip" argument.

As the enormous fiscal problems manifest in the proposed budget make clear, however, there is reason to question just how many new bargaining chips the United States can afford to put on the table. A projection for defense spending in fiscal 1975—still another year ahead—shows outlays rising to $85.5 billion, or $4.4 billion over the outlays now proposed for 1974, with military pay and retirement benefits again the major factor in the increase. It will be ironic indeed if the "all-volunteer force" that has emerged as a legacy of Vietnam should turn out to be a built-in inducement to arms limitation.

—LUTHER J. CARTER

Space

The space program seems to be alive and well as it makes the transition into the post-Apollo era, despite recent fears at the National Aeronautics and Space Administration (NASA) that its activities might be cut back severely. NASA's fiscal 1974 budget of $3.1 billion is little more than half what its budget was at the peak of preparations for Apollo but is about the same size as this year's. Commenting on the new budget, NASA administrator James C. Fletcher pronounced the space program to be "balanced" and "surprisingly strong." Manned spaceflight activities will remain important, but with the unmanned and scientific activities claiming a larger share of the NASA budget than they have in the past. The experimental space station Skylab will be launched on schedule, in May of this year; the Apollo-Soyuz Test Project, the joint flight with the Soviets, will take place in the summer of 1975; and the first orbital launch of the space shuttle—the reusable vehicle intended to cut the cost of carrying astronauts and heavy payloads into space—is to come in 1979.

In the field of unmanned planetary exploration, a Pioneer mission to Jupiter and a Mariner Venus-Mercury mission

will be launched later this year, to be followed by a Mariner Jupiter-Saturn mission in 1977. The Viking orbiter/lander mission to Mars is set for 1975–76. Other activities will include the launching of the Orbiting Solar Observatory in 1974, of two German-American solar probes in 1974 and 1976, and of a number of technological "applications" satellites (for earth resources reconnaissance, weather studies, and the like) between now and the end of 1977. With the foregoing manned and unmanned space activities, together with a modest program in aeronautics, NASA would have about 25,000 civil service employees throughout the 1970's and support about 100,000 contractor personnel (the latter figure going somewhat higher at the peak of work on the space shuttle).

A clear indication that NASA's major programs were safe (certainly for the moment) came several weeks ago when the agency, faced with White House demands to do its part toward holding total federal spending for fiscal 1973 to a $250-billion ceiling, escaped with a cut of only $179 million. To make the cut, development of the shuttle was ordered slowed by somewhat less than a year off of its original schedule and the launch dates for two of the technological applications satellites was ordered delayed. In addition, there were decisions to suspend the High Energy Astronomy Observatory project (pending redesign of HEAO in a cheaper configuration), to phase out the communications satellites project (letting industry take over), and to terminate long-term projects for development of nuclear propulsion and large-scale nuclear power sources.

Should there ever come a decision to kill or indefinitely postpone the space shuttle, the agency's status may slip to that of an inconspicuous scientific and technological agency quietly doing interesting but not very exciting things. The shuttle is in fact critical to NASA's future, as that future is now envisioned. During this decade as much as a third of the agency's civil service personnel and up to one half or more of its contractor personnel will at times be working on this project. And, for the long term, once the shuttle becomes operational—at a total cost of at least $6.5 billion—an ambitious program of flights will have to be carried out to justify having built it. In terms of cost-effectiveness, the shuttle does not start breaking even unless at least 30 heavy scientific, military, or other payloads are launched annually over a 12-year period.

NASA officials probably are not going to be able to rest easy about the shuttle until a few billion dollars have been spent on it. Not more than about $775 million will have been spent by the close of fiscal 1974—little enough that the Administration might be tempted to cancel the project should severe budgetary difficulties again arise.

Yet NASA officials seem confident that the shuttle will be built, and there perhaps is little reason to believe otherwise. President Nixon has supported the project—although his new budget message contained no mention of the space program whatever—and, in Congress, it has survived handily all past attempts to kill it. The fact that the project helps sustain an aerospace industry that has suffered grievously from layoffs is a point lost on no one. And, then too, NASA has going for it the fact that, both in Apollo and in the unmanned programs, it has generally met its goals and stayed within its budget.—L.J.C.

Supersonic Technology

Ever since that day two years ago when the White House lost, by a close vote in the Senate, the battle to keep the supersonic transport alive, there has been speculation that President Nixon would ultimately seek to revive the project. The evidence now is that the President does indeed look to a possible revival of the SST, but not until later in the 1970's. The new NASA budget contains $28 million—more than twice as much as last year's budget—for research and development on supersonic technology. The work will focus on problems of noise, pollution, and efficiency of configuration.—L.J.C.

RESEARCH NEWS

Cholera: New Aids in Treatment and Prevention

The current epidemic of cholera, which began a decade ago in Indonesia and is still rampant on the Indian subcontinent and in Africa, has stimulated research on the biochemical and immunological, as well as the clinical, aspects of the disease. It is now known that the profuse diarrhea of cholera is caused by a toxin made by *Vibrio cholerae*, the bacterium that causes cholera. In the intestine this toxin stimulates the enzyme adenylate cyclase, which in turn causes production of an excessive amount of cyclic adenosine 3′,5′-monophosphate (cyclic AMP). Then, by a mechanism still not understood, the cyclic AMP induces the hypersecretion of water and salt characteristic of the disease.

Effective therapy for cholera now consists of replacement of the water and salt lost through diarrhea; when initiated early enough, this therapy can save almost all victims. Although cholera is best prevented by modern sanitation and clean water supplies, improved vaccines may be a more readily attainable means of reducing the incidence of cholera in underdeveloped areas of the world. Preliminary evidence suggests that an inactivated form of the toxin (toxoid) may be superior to the vaccine made of killed *V. cholerae* that has long been in use.

The diarrhea caused by cholera results in the loss of large amounts of body fluids and electrolytes (sodium, potassium, chloride, and bicarbonate ions). Although these losses have been attributed to the effects of cholera toxin, the precise site of action of the toxin was identified only recently. For example, Michael Field, working first at Johns Hopkins University and later at the Beth Israel Hospital in Boston, discovered that cholera toxin increased the amount of chloride ion secreted by the intestine and decreased the net ab-